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POPULATION GROWTH AND INTERNAL MIGRATION IN COLOMBIA

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PREFACE

This Memorandum is part of a study of Colombia undertaken at The RAND Corporation under the sponsorship of the U.S. Agency for International Development, with supplementary funds provided by the Corporation. These interrelated investigations into the development process in Colombia seek to help AID formulate policy and establish priorities in Colombia, and illuminate a more general class of problems incurred in fostering development throughout the world. Other Memoranda in this series are: R. R. Nelson, A Study of Industrialization in Colombia, Part I: Analysis, RM-5412-AID, December 1967; R. L. Slighton, Urban Unemployment in Colombia, RM-5393-AID, January 1968; T. P. Schultz, Returns to Education in Bogota, Colombia, RM-5645-AID/RC, September 1968; R. R. Nelson, The Effective Exchange Rate, Employment, and Growth, RM-5680-AID, November 1968; R. L. Slighton, Relative Wages, Skill Shortages and the Distribution of Income in Colombia, RM-5651-AID/RC, November 1968; and R. R. Nelson, R. L. Slighton, and T. P. Schultz, Colombian Development Policy, R-461-AID/RC, February 1969.

This Memorandum is concerned with the growth of population and the process of internal migration that is currently concentrating the population of Colombia in and around the cities. This demographic phenomenon has economic causes that must be understood and confronted directly if policy is to be effective in coping with the consequences. Virtually all problems of resource reallocation that are fundamental to the development process become more difficult and necessary under the burden of accelerating population growth.

The author wishes to acknowledge the contribution of Jesus M. Melgarejo Rey, Chief of the Census Division, Colombian Department of Statistics, for his assistance in the collection of unpublished municipal tabulations from which the sample of the 1964 Colombian Census of Population was drawn. Catherine Exton and Robert Butler of RAND assisted in the processing of the Colombian data. RAND colleagues Richard Nelson, John Stromberg, Eleanor Sheldon, and

T. W. Schultz all read a draft of this Memorandum and gave judicious and helpful comments.

SUMMARY

Rapid population growth is a poorly understood part of the development problem facing many low-income countries today. In recent years Colombia has experienced one of the world's most rapid population growth rates and sustained unprecedented internal migration movements. This Memorandum investigates the causes for this rapid population growth and the associated patterns of internal migration. Quantitative analysis of these demographic and economic phenomena provides evidence on their determinants and suggests a framework for the design and evaluation of policy to cope with them.

The first part of the Memorandum deals with the determinants of fertility and population growth. A working hypothesis is advanced that the frequency of births in a population can be understood partly in terms of the resources and constraints of parents' environment that modify their desires for births. Without complete registration of births in Colombia, an analysis of interregional differences in fertility must consider a proxy for the unobserved birth rate. The proxy analyzed here is the ratio of young children to women in the childbearing ages as enumerated in the 1964 Census. A random sample of 131 Colombian municipalities indicated this proxy for municipal birth rates is significantly negatively associated with those environmental characteristics that were expected to reduce desired birth rates: labor force participation of women, and child and adult education. Additional features of the environment that are commonly linked to fertility are not found to be significantly associated with this proxy for birth rates: rural or urban residence, agricultural activity, growth of wages, and prior immigration into the community. These findings suggest that urbanization and rising incomes may not in themselves reduce birth rates and dampen population growth. However, wider dissemination of basic education, improved employment opportunities for women, and better child and maternal health services promise to reduce fertility indirectly.

The second part of the Memorandum estimates and analyzes the currents of internal migration in Colombia between the censuses of 1951 and

1964. About one-third of the rural population under the age of 40 in 1951 had departed these areas of Colombia by 1964. This large outflow of rural migrants approximately equalled the excess of births over deaths in these areas. Small towns, on balance, also lost to migration, but this small net outflow may conceal larger gross migration rates. The growth of cities larger than 10,000 was spurred by heavy in-migration of almost 2 percent per year. About 2/5 of the population growth of these cities appears to have been realized through migration. Because the migrant tended to be young and economically active, migration contributed greatly to the growth of the urban labor force and held the rural labor force virtually constant.

A model of interregional migration is then developed and estimated within the data limitations for Colombia. The rural to urban pattern of migration is largely understood in terms of rates of population growth and levels of agricultural wages. Education has a more complex role in increasing migration to the cities. It appears to hinder or postpone migration among the school-aged children and their parents, but accelerate the out-migration rates among older youth that constitute the majority of migrants. Also, the incidence of rural violence is strongly associated with rural out-migration of men and women of all ages, except for men between the ages of 17 and 21. If these estimated migration relationships are constant for the next decade, rates of internal migration from the countryside to the cities are likely to rise as a consequence of the mounting pressures of population growth and persisting stagnation of agriculture.

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I. INTRODUCTION

The surge of population growth that is overtaking Colombia today contributes unquestionably to the severe problems that country encounters in maintaining its forward momentum in the development process. But population growth is not exogenous to the development process, it is itself determined by the social and economic environment of the Colombian people. The timing and extent of the postwar decline in death rates, which is the proximate cause for the increased rate of population growth in most less developed countries, can be traced to easily transferred knowledge and techniques of public sanitation, disease control, and public health services. But after a certain point the effectiveness of these new inputs in reducing death rates further is narrowly circumscribed by rising nutritional standards of the population and their environment and general standard of living.[1] Nor is the decline in death rates independent of other decisive structural changes in the society that are imperative for economic advancement. For example, increased life expectancy adds to the attractiveness of all forms of human investment, such as migration, education, and vocational training, which are essential for both the efficient sectoral redistribution of the labor force and the rapid expansion of the modern industrial sector of the economy. To design appropriate policy measures to cope effectively with the problems of rapid population growth and urbanization, a better understanding of the causes of high fertility and rural-urban migration is needed. This Memorandum uses quantitative tools of analysis to investigate the social, political, and economic causes of these phenomena.

The large difference in birth rates between developed and less developed countries is often attributed to the practice of birth control in the former and its absence in the latter. But the conspicuous

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[1] See, for example, Walsh McDermott, "Modern Medicine and Demographic/Disease Pattern of Overly Traditional Societies," paper presented at the Institute on International Medical Education of the Association of American Medical Colleges, Washington, D.C., March 28, 1966.

variation in birth rates within and among less developed countries is difficult to account for unless "natural fertility" is affected by other factors than the availability and use of modern contraceptives. One approach to understanding these differences in fertility is to begin with the preferences of parents for children, and seek the determinants of birth rates among the observable characteristics of their environment that could influence their opportunities and goals. The working hypothesis here is that the frequency and timing of births among regional populations are a function of environmental factors that modify parents' desires for births and exert, in subsequent years, an observable influence on the actual birth rate.

The first part of this Memorandum elaborates and tests this family size goal hypothesis for Colombia, though severe gaps in data are encountered. Empirical analysis, therefore, focuses on an indirect proxy for the surplus of births over deaths, so-called surviving fertility, and attempts are made to test only a few of the many implications of the working hypothesis.

Internal migration in Colombia has also increased of late. Some migrants appear to move toward the remaining frontier lands, but the large majority, in search of a better life, have converged on the large towns and cities. Some consequences of this demographic-economic development for Colombia are documented in other Memoranda: urbanization has occurred more rapidly than industrialization, and assimilation of migrants into the urban economy is not always progressing satisfactorily; urban unemployment has risen, and the proportion of urban workers employed in low-productivity and low-wage sectors of the economy has tended to rise; though the modern sectors, where labor productivity and wages are high and rising, have expanded output under the stimulus of import substitution programs, the growth of employment has been disappointing and highly susceptible to periodic shortages of foreign exchange.[1]

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[1] R. L. Slighton, Urban Unemployment in Colombia: Measurement, Characteristics and Policy Problems, RM-5393-AID, January 1968; R. R. Nelson, A Study of Industrialization in Colombia: Part I,

The second part of this Memorandum investigates the causes for the unprecedented rates of internal migration that are occurring today in Colombia. From a sample of municipalities, age, sex, and region specific migration flows are estimated and discussed in Section III. A model is offered in Section IV to account for these interregional migration rates, and the model is fitted to the sample data in Section V, yielding estimates of the responsiveness of internal migration to economic, demographic, and political developments in the rural and urban sectors of Colombia. The concluding section summarizes the empirical findings and relates them to policy priorities.

Analysis, RM-5412-AID, December 1967; T. P. Schultz, Returns to Education in Bogota, Colombia, RM-5645-RC/AID, September 1968; R. R. Nelson, The Effective Exchange Rate, Employment, and Growth in a Foreign Exchange Constrained Economy, RM-5680-AID, November 1968; R. L. Slighton, Relative Wages, Skill Shortages, and Changes in Income Distribution in Colombia, RM-5651-RC/AID, November 1968.

II. POPULATION GROWTH

The annual rate of growth of the Colombian population appears to have increased from about 2 percent in the 1940s to more than 3 percent in the 1960s. An abrupt decline in death rates from around 25 to 15 per thousand following the war is largely responsible for this marked acceleration, but of greater interest for the future of Colombia is an understanding of the forces that perpetuate the high rate of growth. Before considering the possible causes it may be helpful to review the characteristics and consequences of the "population explosion."

DEMOGRAPHIC CONDITIONS AND CONSEQUENCES

The excess of births over deaths appears to be of about the same magnitude whether in rural or urban areas of Colombia.[1] But this parity conceals two significant underlying differences. Both birth and death rates appear to be higher among rural than among urban residents. In addition, differences in crude birth rates do not reflect fertility differences in the two populations, for rural-urban migration has reduced the proportion of women of childbearing age in the rural compared with the urban population.[2] Without reliable vital statistics or other direct evidence on fertility in Colombia by region, one can only show that the ratio of young children (less than 5 years of age) to women in childbearing ages (15-49) was about 40 percent higher in rural than in urban areas as of 1964. Although this indirect

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[1] For estimates of Venezuela, Mexico, and Chile see E. Arriaga, "Components of City Growth in Selected Latin American Countries," Milbank Memorial Fund Quarterly, Vol. 46, No. 2, April 1968, pt. 2, Table 6, p. 246.

[2] Fertility is here used to denote the number of children a woman bears throughout her lifetime. Since this longitudinal measure of fertility is difficult to obtain and then directly available only for older women, some compromise in measurement via age standardization of the crude rate is often used. Greater detail on the age and sex composition of migration is presented in Section III of this Memorandum.

measure of fertility is likely to understate the actual difference in the frequency of births to rural and urban women of similar age composition, it strongly confirms that differences in birth rates are substantial between these two groups in the population.[1]

Though the natural rate of increase of the rural and urban populations has been about the same, the growth of each and the distribution of the population has been altered considerably by internal migration. Between 1951 and 1964 the rural population of Colombia grew at about 1 percent per year, while the urban increased annually 5 percent. Table 1 presents the data on the 16 largest cities in Colombia.[2]

It is obvious that the main effect of this surge in population growth on the size of the Colombian labor force would be delayed for a generation; it is gradually becoming evident in the 1960s. It is estimated (Appendix A) that the labor force grew at 2.2 percent per year between 1951 and 1964, and that it is likely to grow at about 3 percent per year in the next decade. The additions to the labor force, as one might expect, are differentially absorbed by the urban and rural sectors. Because migration is selective, drawing forth young adults, the rural and urban labor forces grew at .4 percent and 4.4 percent per year respectively between 1951 and 1964. To take an extreme case of the impact of internal migration, Table 2 shows that the majority of the residents of rapidly growing Bogota in 1964 were in-migrants to that city; among the economically active ages (15-59), three-fourths were born outside of the city, and almost half had in-migrated in the past eleven years.

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[1]First, this indirect measure of fertility conceals the offsetting effects of more frequent births and early child deaths to rural than to urban women. And second, urban women of childbearing age are more concentrated in the high fertility younger age groups than rural women and thus would, other things equal, be expected to show a higher ratio of children to women.

[2]As seen in Table 1, the 16 cities that exceeded 100,000 by 1964 grew even faster at 5.6 percent, and Bogota led with an annual rate of population growth of 6.8 percent per year.

Table 1

POPULATION GROWTH IN THE MAJOR CITIES OF COLOMBIA
BETWEEN CENSUSES: 1938-1964

City by Size in 1964	Census Population Total (thousands)			Annual Average Rate of Growth (percent)	
	1938	1951	1964	1938-1951	1951-1964
Bogota D.E.	356	715	1,697	5.4	6.8
Medellin	168	358	773	6.1	6.0
Cali	102	284	638	8.3	6.3
Barranquilla	152	280	498	4.8	4.5
Cartagena	85	129	242	3.3	4.9
Bucaramanga	51	112	230	6.3	5.6
Manizales	86	126	222	3.0	4.4
Pereira	60	115	188	5.2	3.8
Cucuta	57	95	175	4.0	5.4
Ibague	61	99	164	3.6	3.9
Palmira	41	81	141	4.7	4.3
Armenia	51	78	137	3.4	5.4
Monteria	64	77	126	2.7	3.8
Cienega	47	57	113	1.4	5.4
Pasto	50	81	113	3.9	2.5
Santa Marta	33	47	104	2.8	6.2
Total	8,850	11,589	17,567	2.1	3.3

Source:
Bolletin Mensual de Estadistica, DANE, Bogota, Colombia, No. 176, November 1965, p. 7.

Table 2

PERCENT OF PERMANENT POPULATION NOT BORN IN THE CITY, BY SEX, AGE, AND DURATION OF RESIDENCE: BOGOTA, 1964

Sex and Age (years)	Total	Duration of Residence in Bogota		
		0 to 5	6 to 11 (years)	12 or more
Male:				
0-14	23.5	17.6	5.2	.7
15-59	72.7	29.6	15.2	27.9
60 or more	81.2	18.0	9.5	53.7
All ages	51.1	23.8	10.6	16.6
Female:				
0-14	25.7	19.6	5.3	.8
15-59	75.1	29.6	16.1	29.4
60 or more	83.6	19.9	10.5	53.1
All ages	55.8	25.2	11.5	19.0
Both sexes all ages	53.6	24.6	11.1	17.9

Source:
Derived from unpublished 1964 census tabulations.

Analysis of the rate and structure of internal migration is postponed to later in this study. This section offers an economic framework for interpreting some features of the Colombian environment and their implications for the level of birth rates. An examination of surviving fertility from a cross section of Colombian municipalities sheds some light on the possible relevance of this approach in determining birth rates in Colombia, and the prospects for the future.

THE FAMILY PLANNING HYPOTHESIS AND THE ECONOMIC CAUSES OF POPULATION GROWTH

The Family Planning Model is built around three factors assumed to exert a systematic effect on the actual frequency of births in following periods: (1) a family size goal or a number of surviving children that parents want, which is determined by a host of environmental factors modifying the relative attractiveness of few versus many children; (2) the incidence of death, mainly among offspring, which necessitates a compensating adjustment in birth rates to achieve any particular family size goal; and (3) uncertainty in the family formation process where deaths, births, and remarriage are unpredictable.[1]

The Family Size Goal

Parents value children for themselves, but in less developed countries particularly, children also contribute to family resources from an early age. Balanced against the benefits of having children there are also costs: opportunity costs of time parents spend with their children, and pecuniary costs of goods and services required to feed, clothe, shelter, and educate a child. Parents' resources, in terms of time and wealth, constrain the activities undertaken, including the number of children they can rear.

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[1] The model is elaborated more fully in T. Paul Schultz, A Family Planning Hypothesis, RM-5405-RC/AID, December 1967; and in "An Economic Model of Family Planning and Fertility," Journal of Political Economy, Vol. 77, No. 2, March/April 1969.

As an introduction to more formal and quantitative analysis it is useful to discuss briefly several characteristics of a community that seem likely to affect the subjective or pecuniary net cost of having children. The following are considered central: (1) opportunity income and opportunities of women and men, (2) the allocation of children's time between school and work, (3) institutions, (4) birth control.

Opportunity Income of Women and Men. To devote her time to her children, a mother forgoes the opportunity to earn additional income or undertake other activities; this opportunity cost of children is an important part of the total costs of rearing children, and a part that appears to grow as a society advances economically. When women can easily find good jobs outside of the home, they tend both to participate frequently in the labor force and to appreciate the opportunity costs associated with enlarging their family or lengthening their years of child rearing. One expects, therefore, and generally finds in an environment where women can earn more income (per unit time), higher female participation rates, lower birth rates, and shorter intervals between births, other things being equal.[1]

Typically the main source of family income is that of the male head of household. A change in his income may have a variety of effects on parents' desires for children. An unanticipated but permanent change

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[1]Each of these simple associations between women's earnings, activity, and fertility can be verified with U.S. data, and international comparisons also appear to be generally consistent with these direct implications of the opportunity income hypothesis. For example, see G. Cain and A. Weininger, "Economic Determinants of Fertility," mimeo., April 1967; Cain, Married Women in the Labor Force: An Economic Analysis, University of Chicago Press, Chicago, 1966; United Nations, Population Bulletin, No. 7, 1963; P. Whelpton, "Trends and Differentials in Spacing Births," Demography, Vol. 1, 1964. There are some exceptional cases documented by Stycos in Lima (among domestic servants) and in Turkey where economic activity of women is not negatively associated with fertility -- but single factor correlations are not a satisfactory test of the nature of partial effects of one among many determinants of complex behavioral patterns. See for example, J. M. Stycos and R. H. Weller, "Female Working Roles and Fertility," Demography, Vol. 4, No. 1, 1967, pp. 210-217; and Stycos, "Female Employment and Fertility in Lima, Peru," Milbank Memorial Fund Quarterly, Vol. 43, No. 1, January 1965, pp. 42-54.

in family income would appear to change, in the same direction, the number of children parents can expect to rear at their current standard of living.[1] However, in the long run, a permanent shift in income is usually translated into a new standard of living for parents and children alike. Though parents have some latitude in the standard of living they provide their children, the standards deemed socially acceptable rise with parents' income and status. Exactly how these countervailing effects of an unexpected permanent change in income and a subsequent change in child costs balance out cannot be predicted a priori.[2]

Child Labor and Education. Children may also be gainfully employed. Until children can earn more than they consume, they rely economically on the family. The extent to which potential child earnings are captured by the parent depends on the alternative opportunities for children to attend school or to assist their parents, and the social attitudes toward child labor practices within and outside the home. At a later age when children can earn more than they consume, a host of cultural and economic factors are likely to determine what fraction of this "net income" is claimed by parents. Regardless of the underlying determinants of child labor practices in the community, the prevalence of unpaid family workers should be associated with larger benefits or lower net costs for rearing children.

School for children, therefore, even when provided free by the state, imposes opportunity costs on parents. Even if children do not work outside the home, they provide help in the home by tending younger children and performing routine household chores. This help is restricted when they attend school. School attendance also adds as a rule to direct household outlays for better clothes, school materials,

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[1] Because children represent a long-term irreversible commitment, parents are not likely to respond to a change in income by adjusting the final number of children they want unless they view the change as permanent. The timing of births, on the other hand, might be altered in response to transitory changes in income.

[2] This issue is discussed at greater length in Schultz, "An Economic Model of Family Planning and Fertility."

transportation, and support away from home. The parents' decision to send their children to school thus increases child costs and may be a strong determinant underlying the family size goal. Having more children or providing fewer with additional opportunities for schooling may be an important watershed in the transition from so-called traditional values where reproductive behavior was consistent with a regime of high childhood mortality and low social mobility, to so-called modern values where reproductive behavior adjusts to conditions of low mortality and higher mobility in accord with the individual's talents, training, and formal education. For investment in the productive capabilities of children to be attractive, the chances for child survival and opportunities must be good.

The schooling of parents may also, plausibly, affect their family size goal; the education of parents is closely associated with their opportunity income, and thus with the opportunity cost of the parents' time spent attending to the needs of their children. Since children tend to be a relatively time intensive involvement, parents' education may underlie their relative evaluation of having a large family or allocating more of their time and resources to other activities. Schooling may give parents easier (cheaper) access to birth control information, contributing to their earlier and more reliable adoption of family limitation. Behavioral patterns of better educated parents may be more flexible and capable of coping with environmental change, such as an unanticipated decline in death rates as has occurred in Colombia. Finally, the willingness of parents to invest in their child's education may hinge on how much schooling they had. It is possible, therefore, that the schooling of each generation paves the way for the increased educational opportunities enjoyed by the next, increasing the costs of rearing children.

Institutions. Income and wealth transfers between generations and from active workers to inactive aged and infirm depends in part on the structure of the family. The extended family tends to shelter both the old and young; parents have socially approved claims on their offspring's future earnings if their own means of support are exhausted,

just as young parents turn to the extended family for support of their children when their current earnings are deemed insufficient. The scope and necessity of these family production and redistribution relationships appear to be a function of the average level of wealth in the society and the specific activities undertaken by the state.[1] These family institutional factors are judged to be important by some observers in determining family size goals, but empirical evidence is scant, and Colombian data are not rich enough to specify this facet of the family setting.

Birth Control. The costs of birth control consist of first acquiring and evaluating information about alternative contraceptive methods and then outlays and inconvenience associated with using a method. Traditional methods of birth control are less reliable and less convenient than modern ones.[2] Where the range of alternatives is limited to traditional methods, large costs must be incurred to achieve a high degree of reliability, as in the extreme cases of continence, dissolution of marital unions, and induced abortion. For the individual living in a "traditional" community, it may be very costly to search independently for a more reliable and a more convenient (modern) method of contraception, whereas for a society as a whole, informational costs are perhaps more modest per capita because of economies of scale in disseminating information. It should be stressed, however, that the personal costs associated with the

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[1]The government may, for example, proscribe child labor, enforce school attendance, institute support programs for the aged and unproductive persons, and provide compulsory insurance programs of disability, medical care, and retirement. Public policies further impinge directly on the costs and benefits of children versus other private resource uses by government tax and expenditure policies, which extend, on one hand, personal deductions and dependency allowances on taxes, and on the other hand, provide for public health, education, and welfare services.

[2]Though pregnancy rates differ among populations practicing similar methods of contraception, largely because of differences in motivation and understanding, the greater reliability of modern compared with traditional methods of contraception is on the order of 10 to 1. Costs and inconvenience also appear to favor modern over traditional methods of contraception.

adoption and use of contraception are poorly understood and very difficult as yet to appraise empirically.

Other Factors. Many other factors undoubtedly play a role in determining the relative attractiveness to parents of having a few or many surviving children, but for the scope of this study this abbreviated list of more important factors provides a useful starting point for evaluating the predictive power of the family planning hypothesis for Colombia. It is assumed, of course, that the environmental variables that are omitted from the analysis are uncorrelated with those included. Having settled on a desirable number of surviving children, parents may then decide, prospectively and retrospectively, how many births are needed to achieve that family size goal.

The Incidence of Death

In exercising some control over births to achieve a certain surviving size of family, parents must take into account the incidence of death among their offspring. Neglecting for the moment the uncertainty of outcome that stems from the unpredictability of births and deaths within a particular family, the family planning hypothesis implies that parents try to compensate for the average incidence of death by seeking the number of births that will give them the desired number of surviving children. Two behavioral mechanisms may be involved in this compensating adjustment of birth rates to death rates: a long-run expectations mechanism that may work primarily via changes in accepted patterns of marriage, birth timing, and spacing, and a short-run replacement mechanism that may emerge several decades after the onset of the decline in child death rates.

First, the established regime of childhood mortality may influence parents in planning their lifetime reproductive behavior to compensate for what they expect to be the incidence of death among their offspring. If the death rate for children is high, this adjustment may take the form of earlier marriage, earlier initiation of child bearing, and more

frequent remarriage. Second, since mortality in childhood is concentrated in the first years of life, parents may make an added effort to have an additional child when they lose one of their children. This presumes that some still fertile women already have the number of living children they want, and without their child's death would seek to avoid further births. A decade or two after child death rates decline, when large numbers of parents reach their surviving family size goal before menopause, fluctuations in child death rates are likely to exert a pronounced effect on the birth rate among this group of older women.[1]

Although these two behavioral mechanisms are distinct, it is empirically difficult to distinguish between them with the available demographic data because the usual expectation model and the replacement model imply similar adjustment equations for the purposes of empirical estimation. Regardless of the relative importance of these two mechanisms, the implications are clear that for a community current birth rates are likely to be influenced by recent past and future expected death rates.

Uncertainty

When parents desire a certain number of surviving children, they undoubtedly realize that they cannot assure the outcome they want. Rather, their actions influence only the range and probability of possible outcomes. This recognition of uncertainty in the family formation process may induce parents to aim for more or fewer children (births) than they would desire under a predictable regime of deaths and births. There is a close link between the level of death rates and the degree of uncertainty attaching to the family formation process. Where increased uncertainty has the effect of inducing parents to seek more births, both the direct effect of death rates and the indirect effect operating through uncertainty will tend to influence objective

[1] This implication of the model is confirmed by an analysis of Puerto Rican data reported by Schultz, "An Economic Model of Family Planning and Fertility."

birth rates in the same direction. Separating these direct and indirect effects of death rates statistically may prove difficult in most contexts, and impossible in Colombia where reliable information on child death rates is altogether lacking.

In summary, parents' decision to seek a particular number of births is interpreted as a function of (1) the character of their environment that affects their revealed preferences for surviving children, (2) past or expected child death rates that necessitate compensating adjustment in birth rates, and (3) the uncertainty associated with births and deaths that may induce parents to increase or reduce the number of births they seek. This family planning hypothesis is next translated into a model that yields implications for reproductive behavior that are subject to empirical verification.

TOWARD EMPIRICAL EVALUATION OF THE MODEL

Parents may decide on the number of children they want in the context of their environment, but a variety of other decisions bearing on their present and future lives may also be involved. The problem is to specify a relation between the number of births parents want and environmental variables that are not themselves determined simultaneously with or subsequently by the objective number of births. In this exploration of the implications of the family planning hypothesis, it is assumed that the factors determining birth rates are themselves predetermined.[1]

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[1] A later study of other developing countries will attempt to specify and estimate the more prominent simultaneous relationships among which will be family decisions relating to the frequency or number of births wanted. Neglecting interactions among family behavioral decisions biases our estimates of the effects of environmental conditions on the frequency of births; but it is hoped this simultaneous equation bias is not large, and the findings of this partial analysis represent a tentative step toward understanding the complex of household decisions pertaining to participation, migration, and fertility.

The Hypothesis and Implications

The family planning hypothesis implies that there exists a multivariate relationship between equilibrium birth rates and the features of parents' environment. Under plausible assumptions about the functional form, the model implies that current birth rates are a linear function of past gradually changing environmental constraints, and a distributed lagged adjustment to recent death rates.[1] From the earlier discussion, it may be predicted that female opportunity income, or its proxy the participation of women in the labor force, child schooling rates, and perhaps adult educational attainment will be associated with higher child costs from which we infer birth rates are likely to be lower. Conversely, the employment of child labor within the family will tend to have the opposite effect. Birth rates should be positively related to child death rates. The effect of uncertainty cannot be predicted *a priori* since it depends crucially on the asymmetry of parent cost functions, but it is plausible that in less developed countries reduction in uncertainty will contribute to a reduction in desired number of births.

Empirical Evidence

The purpose of this section is to see if differences in birth rates across regions in Colombia are as predicted by our model, and more precisely what features of the Colombian environment are strongly associated with signs of retardation in the rapid rate of population growth.

Births and deaths are not reliably known at the regional level for Colombia. The major source of regional data is therefore the Census of Population. Though the 1964 Census is not yet entirely

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[1] Since in the case of Colombia one is unable to consider more than one cross-section of regional observation without reliable information on death rates, these dynamic aspects of the model are not further developed here. The assumptions and the entire econometric model implicit in this discussion are set forth in Schultz, *A Family Planning Hypothesis: Some Empirical Evidence from Puerto Rico*.

published, a 15 percent sample of 131 Colombian municipalities is selected from preliminary census tabulations and matched to the same regional information published for the 1951 Census. The design and shortcomings of this sample are discussed in Appendix B. The age composition of the population as recorded in the Census may then be used to judge fertility levels for these municipalities.[1] This procedure does not permit one to estimate birth and death rates independently of one another, for the regional populations of Colombia are subject to appreciable net migration flows.[2] The age composition, however, does provide a basis, albeit approximate, for estimating a measure of "surviving fertility," or a proxy for the rate of natural

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[1] Three studies have attempted to examine fertility, mortality, and in some cases migration rates by Department for Colombia. A U.N. study directed by Grauman sought to project demographic trends based on data for 1938-1951, and analyze some of the implications of these trends. Cuervo in a CELADE paper studied the differences in fertility across Departments, and demonstrated that the 1951 Census age compositions imply radically different fertility patterns from registered rates (which are grossly deficient in several Departments). Berry used Grauman's fertility and mortality estimates by Department, and suggests how these vital rates may be linked to various social and demographic characteristics. None of these studies utilized the 1964 Census materials, nor examined data at the municipality level. Alvaro Lopez is preparing a study of Colombian population growth based on the 1964 Census results, but it was not available as of 1968. See Some Aspects of Population Growth in Colombia, prepared by the Secretariat of the Economic Commission for Latin America, Economic and Social Council, United Nations, E/CN.12/618, 10 November 1962; Lilia Ines Cuervo Gomez, Fecundidad Diferencial de Colombia por Secciones Politico-Administrativas, Centro Latinoamericano de Demografía, Santiago, Chile, E/CN.CELADE/C.21 B.61.1/5.Rev.1, 1964; R. Albert Berry, Breve Estudio de los Determinantes del Crecimiento de la Poblacion en Colombia, Centro de Estudios Sobre Desarrollo Economico (CEDE), Universidad de los Andes, Bogota, Colombia, March 1965.

[2] Even if the assumptions often advanced to proceed with quasi-stable population theory estimates of vital rates were granted, there is no general way to contend with interregional migration which radically affects the age compositions of regional populations. At the national level, it may be assumed that net migration flows into or out of Colombia in this period were negligible, and thus it is feasible, as shown in Appendix B, to estimate Colombian national average birth and death rates. But regional estimates of vital rates must rely on less reliable evidence of the net balance between birth and child death rates, as reflected in child/woman and child/population ratios of the traditional sort.

increase of the regional population.[1] More precisely, the proportion of young children in a regional population reflects two inseparable phenomena: the regional frequency of births and the regional incidence of child deaths. If, as appears to be the general case, the level of birth rates and child death rates are positively correlated across regions in Colombia, this synthetic measure of surviving fertility derived from child/woman and child/population ratios will vary less across regions than the actual birth rate, but will correspond approximately with both the long-run size of surviving family in the region and the rate of natural increase of the population, that is, the growth rate of population before migration.[2]

The earlier discussion of the family planning hypothesis identified several features of the local environment that are likely to influence the size of surviving family parents would desire. Women's activity in the labor force, though difficult to measure reliably, probably corresponds with income opportunities existing for women outside of the home. Though a serious problem of the simultaneous determination of reproductive and participation behavior exists, we assume for lack of regional data on women's opportunity wage that women's participation in the labor force is predetermined and is a satisfactory proxy for opportunity wage.

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[1] Four linear estimates of the crude birth rate (uncompensated for the incidence of child death) are computed and averaged, based on the ratio of children (age 0-4 and 5-9) to women of childbearing age (15-49) and on the ratio of children (age 0-4 and 5-9) to total population. The linear estimates are borrowed from a cross-sectional analysis of some 50 countries by Bogue and Palmore. The average of the four 1964 estimates is designated our estimate of surviving fertility for each municipality for the decade before the 1964 Census. For regression coefficients, see D. Bogue and J. Palmore, "Some Empirical and Analytic Relations Among Demographic Fertility Measures with Regression Models for Fertility Estimation," Demography, Vol. 1, 1964, Table 8, p. 325.

[2] The counterbalancing effects of interregional birth and child death rates and their impact on child/woman ratios are discussed by Warren C. Robinson, "Urbanization and Fertility: The Non-Western Experience," Milbank Memorial Fund Quarterly, Vol. 41, No. 3, July 1963, pp. 291-308. Puerto Rican data also reveal this interregional pattern. The family planning hypothesis, of course, implies that this pattern is behaviorally determined. See Schultz, "An Economic Model of Family Planning and Fertility."

The effect of the educational process is measured in two ways: school attendance among children and educational attainment of adults. Since child and adult schooling are thought to add to the costs of rearing children in different ways, directly and indirectly, these two measures of schooling are included together in the regression analysis.[1] No measure of age specific labor force participation is available for Colombia by municipality, and thus the effect of unpaid family employment of children or indeed any measure of the work experience of children is omitted in this analysis.

Departing from the central components of the model, several other variables are worth considering, though their relations to preferred size of surviving family are more problematic.[2] Under the plausible assumption that a rapid rise in real wages relaxes parents' resource constraint on having a larger number of children, it is plausible that the level and rate of growth (1952-1965) of local agricultural real wages may be associated with somewhat larger families, other things equal.

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[1]Multicollinearity is not as much a problem as might be expected in considering both child and adult schooling simultaneously in a regression model. For the Colombia sample the simple correlation coefficient between adult and child schooling variables is only .47 in the 1964 Census.

[2]One variable was considered which is not discussed in the text: the relative costs of child rearing. It is assumed that much of the difference in the relative cost of rearing a child in urban and rural settings is due to the higher relative cost of adequate housing in the urban environment. In areas where housing is relatively cheaper (for example, rural), one would expect that consumption of housing would be greater per person, holding wages constant. The reasoning can then be reversed: in the 1951 Census of Housing regions exhibiting a greater number of residence rooms per person are likely to have lower relative costs of housing and child rearing, other things equal. Adding this housing price variable (rooms per person averaged .55 for the sample) to regression 1 in Table 3, it is found to be weakly associated in the expected manner with higher surviving fertility. The R^2 rose from .266 to .271, but the regression coefficient on the housing variable is only .85 times its standard error, and thus significant only at the 20 percent level. With a coefficient of only 2.34, this estimate implies that a 10 percent increment to the housing stock is weakly associated with a small .3 percent increment in the level of surviving fertility or population growth.

Internal migration may also account for some of the interregional variation in surviving fertility. Women in rural areas have more children, on the average, than women living in urban areas. Since the bulk of internal migration in Colombia consists of persons moving from rural to urban residence, the migrant may bring with him more than the urban average number of young children, or continue to want and have a larger number of children than is typical among urban-born residents.[1] In this case, regions in which a large proportion of the local population were in-migrants would tend to record higher levels of surviving fertility than regions, otherwise similar, but in which in-migrants represented a smaller proportion of the population. To test this line of reasoning, the proportion of men in the municipality who were born outside of the municipality is included in the regression model as an in-migration variable.

Finally, we consider the rural or urban nature of the locality. However, characterizing an environment as urban or rural neglects more fundamental differences among environments that are only crudely described by this arbitrary dichotomy. Although urban as compared with rural residence frequently involves a number of changes in family organization and environment that on balance appear to add to the costs of rearing children, and thus may foster lower birth rates among urban than among rural populations, many of these changes are directly

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[1] Zarate has sought to show that urban in-migrants to Monterrey, Mexico, only gradually reduce their fertility toward the level sustained by native-born residents of the city. However, he neglects to make allowances for the differences that undoubtedly distinguish the family environment for the urban in-migrant parents and city-born parents -- differences that may go a long way toward accounting for the different reproductive behavior he correlates with the two groups. Alvan O. Zarate, "Differential Fertility in Monterrey, Mexico," Milbank Memorial Fund Quarterly, Vol. 45, No. 2, pt. 1, April 1967; and "Some Factors Associated with Urban-Rural Fertility Differentials in Mexico," Population Studies, Vol. 21, No. 3, November 1967; and "Community of Origin, Migration and Completed Marital Fertility in Metropolitan Monterrey," paper presented at Population Association of America Meetings, Cincinnati, Ohio, April 1967.

incorporated into our model.[1] For much the same reason, agricultural activity is often thought to be more conducive to higher birth rates than nonagricultural activity. Both the proportion of the population in rural residence and the proportion of the labor force employed in agriculture are considered as explanatory variables in our regression analysis of surviving fertility in Colombia.

Finally, the proportion of adult women married or living in free unions is considered as an intermediate cause for variation in surviving fertility. It must be emphasized, however, that the marriage rate represents an institutional variable which is not likely to be exogenous to desired or surviving fertility, for the timing of marriage patterns is heavily influenced by the environmental constraints and opportunities that simultaneously determine the number of children parents indeed want.[2] Therefore, the inclusion of the marriage rate in the regression model may bias the estimation of the direct effects of environmental variables in surviving fertility.

Empirical Findings

The association between regional surviving fertility from the decade before 1964 and characteristics of the local population and

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[1] A number of factors could add, on balance, to the real costs of rearing children in the urban compared with the rural environment: (1) direct costs of food and housing are likely to be greater for a large family; (2) opportunities to use the productive talents of children to add to family resources tend to be more limited; (3) the need to invest in children's schooling and skills is better understood in the urban environment, hence the associated costs are more often accepted; (4) opportunities for women to work outside of the home are greater, and consequently their potential contribution to family income that is forgone while children are young is larger.

[2] The postponement of marriage is the primary determinant of variation in the proportion of the adult female population married, and this form of institutional adjustment is commonly associated with the more fundamental changes in the environment already included in the analysis. To the extent that marriage is a response to the environmental constraints its inclusion biases downward the other estimates for the environmental constraints. Its omission or non-simultaneous consideration also biases the analysis in ways that are difficult to ascertain.

environment is estimated in Table 3 by ordinary least squares. The principal variables of the model -- child and adult schooling rates and female activity rates -- account for about 22 percent of the interregional variation in surviving fertility in Colombia. Child school attendance and female activity rates are significantly associated with interregional differences in surviving fertility, but adult education falls marginally below the .05 confidence level, its coefficient being only 1.8 times its standard error. The marriage rate, in-migration rate, and growth of real wage variables all have the expected sign in relation to surviving fertility, but none adds significantly to overall relationships or is attributed regression coefficients that are significantly different from zero, at the .05 confidence level.

Though there is a tendency for rural and agricultural regions to record higher fertility rates, as was noted earlier, these differences are accounted for by the education and female activity variables and make no significant additional contribution to explaining interregional variation in surviving fertility in the Colombian sample.

If the relationship estimated in regression 4 of Table 3 were valid a number of probable changes in Colombia would contribute to a reduction in the rate of population growth. A doubling of the child school attendance rate for the age group 5 to 9 from the level of 22 percent in 1964 would imply that many more children received some exposure to the primary educational system in Colombia, a not unreasonable goal. Such an expansion in educational opportunities would be associated with a 5 percent reduction in surviving fertility, and as the proportion of adults with some schooling increased from, say, 62 to 74 percent, this would be associated with an additional 1 percent reduction in surviving fertility. These findings are broadly consistent with those for Puerto Rico and Taiwan: the school system appears to exert a stronger influence on fertility because its demands on the time and energies of children are a burden to parents, than because of its delayed impact on the educational attainment of parents.[1]

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[1] Schultz, A Family Planning Hypothesis: Some Empirical Evidence from Puerto Rico.

Table 3

REGRESSIONS ON ESTIMATED MUNICIPAL SURVIVING FERTILITY: COLOMBIA 1964[a]

Regression Number	Constant Term	Proportion with Some Primary Schooling		Female Activity Rate	Proportion of Women Married	Proportion of Men not Born in Locality	Annual Growth of Real Wages	R^2
		Aged 5-9	Aged 15-59					
1	52.09	-.098 (-2.27)[b]	-.080 (-2.34)[b]	-.108 (-2.92)[c]	.037 (1.98)[b]	.028 (1.53)	.142 (1.34)	.266
2	52.31	-.086 (-2.02)[b]	-.084 (-2.46)[b]	-.112 (-3.03)[c]	.035 (1.87)	.028 (1.52)	NI	.256
3	52.32	-.095 (-2.24)[b]	-.067 (-2.07)[b]	-.116 (-3.12)[c]	.035 (1.85)	NI	NI	.242
4	54.46	-.109 (-2.59)[c]	-.059 (-1.81)	-.120 (-3.20)[c]	NI	NI	NI	.221

Notes:

NI indicates variable not included in regression.

[a]Independent variables expressed in percentages, with growth of real wages measured in agriculture on an average annual basis from 1952 to 1965. Surviving fertility is expressed in terms of a crude birth rate per thousand population that is approximately associated with the proportion of children in the regional population to women and adults of childbearing age (see footnote 1, p. 18). Beneath regression coefficients are t statistics or ratios of coefficients to their standard errors.

[b]Coefficient significantly different from zero at the 5 percent level of confidence.

[c]Coefficient significantly different from zero at the 1 percent level of confidence.

Table 4

MEANS, STANDARD DEVIATIONS, AND CORRELATION COEFFICIENTS
OF VARIABLES USED IN REGRESSION ANALYSIS

	Surviving Fertility Rate	Proportion with Some Primary Schooling		Female Activity Rate	Growth of Real Wages	In-migration (males)	Marriage Rate
		Age 5-9	Age 15-59				
Mean	46.5	22.2	61.7	16.0	.135	28.1	66.0
Standard Deviation	3.64	8.22	10.4	8.19	2.74	16.5	15.4
Correlation Coefficients							
Schooling 5-9	-.151	-					
15-59	.075	.472	-				
Female Activity	-.137	.246	-.125	-			
Growth of Wages	-.124	.202	.016	.002	-		
In-migration	.055	.003	.314	-.150	-.032	-	
Marriage	.201	-.391	-.250	-.309	.034	.095	-

The participation of women in the labor force is likely to continue to increase in Colombia, and a doubling of the current low level of activity among women would be associated with a 4 percent decline in surviving fertility. Major changes such as these are likely to occur in the next decade or two, and according to the estimates presented here, these changes alone would be associated with a 10 percent reduction in surviving fertility and population growth.

POLICY IMPLICATIONS

If these factors, among others, influence the number of surviving children parents desire, the birth rate will also depend on the death rate for children. Though it is not possible to estimate the child death rate in Colombia on a regional level, historical evidence suggests that for birth rates to fall, the chances for child survival must first improve for an extended period. The Latin American countries that are experiencing a substantial decline in birth rates have also had an earlier large fall in death rates.[1] The unanswered question is how long a lag will separate the decline in death rates induced in the less advanced areas of Latin America from the onset of the decline in birth rates.

Mortality among children in Colombia has undoubtedly decreased with the control of some infectious and microbial diseases, but childhood deaths are still much more common than in developed countries. Infant mortality is about four times greater in Colombia than in advanced countries, and death among preschool children (age 1 to 7) is probably thirty times higher. Protein-calorie malnutrition is thought to be responsible for the high death rate in Latin America, contributing to the susceptibility of children to the pneumonia-diarrhea complex of diseases. Essentially non-microbial, these diseases are not readily controlled by modern medical technology without a prior improvement in the child's diet and home environment.[2]

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[1] Argentina, Uruguay, Cuba, Puerto Rico, and Chile.

[2] W. McDermott, "Modern Medicine and the Demographic/Disease Pattern of Overly Traditional Societies: A Technologic Misfit."

Since child spacing is a subtle form of family planning that is uncommon is less-developed countries, most persons seeking reliable birth control methods already have the number of living children they want. Consequently, the demand for birth control and the subsequent decline in birth rates may be expected to lag ten to fifteen years behind the decline in child death rates, and be most noticeable among women 30 years or older. Because of the reduction in child mortality that has already occurred in Colombia, one might expect a large number of women between 30 and 35 in the 1960s will desire the means to avoid additional births. Once the birth rate has begun to decline and there is a potentially fertile group of women preventing unwanted births through reliable means of birth control, fluctuations in child mortality may become associated with (replacement) fluctuations in birth rates, primarily among this older group of women, but with a much shorter lag probably on the order of two or three years. Where means of reliable contraception are not available, abortion and dissolution of marital unions may become more frequent as is already evidenced in Chile and Peru as well as Colombia.

SUMMARY AND CONCLUSIONS

Surviving fertility may roughly parallel the size of surviving family when adjusted for age and sex composition of the population. It was initially postulated that surviving fertility might be affected to some degree by parents' desires for a particular number of surviving children. This proxy for surviving family size may therefore be associated across regions with characteristics of those regions that make more or fewer children attractive. Schooling for children is one such feature of the local environment that indicates parents bear an additional opportunity cost of child rearing, which may contribute to their acceptance of a lower surviving fertility goal. Education for the adult population also increases the opportunity value of parents' time and may alter their preferences between goods and children toward a smaller family size goal. Where women participate in the labor force with greater frequency a higher value is attached to a woman's time,

and consequently child rearing becomes more costly.[1] Each of these features of the municipal environment in Colombia is associated with lower surviving fertility as implied by the family planning model. No significant association is found between level or growth of wages or rural-urban residence and surviving fertility when female participation and schooling are held constant. What do these findings imply for policy?

Increased income or urbanization will not necessarily reduce surviving fertility by itself, though these changes may bring about a salutary reduction in both birth and child death rates without necessarily directly affecting population growth or migration rates. Rather the family environment must change to make more parents seek fewer surviving children. Furthermore, parents must be advised on the most humane and safe means to achieve their diminished family size goal. This may necessitate an active program hastening the diffusion of birth control innovations. The selective expansion of health, education, and welfare programs may encourage parents to seek fewer children.

The association between surviving fertility and parents' environment, though statistically weak in the fragmentary and indirect data examined for Colombia, is revealed with greater clarity when better data from Puerto Rico or Taiwan are examined. Studies from diverse regions of the world find similar patterns of association between lower fertility and lower child mortality in the immediately preceding years, higher child school attendance rates and higher female labor force participation rates.[2] It may be inferred that government programs aimed at instigating changes in these aspects of the parents'

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[1] Not all forms of economic activity undertaken by women necessarily raise the cost of child rearing, for some types of activity may be undertaken in the home or in the company of one's children and thus not represent a conflicting claim on the mother's family rearing responsibilities.

[2] These results are summarized in R. R. Nelson, R. L. Slighton and T. P. Schultz, Economic Development of Colombia, R-461-AID/RC, February 1969.

environment may contribute to initiating a decline in desired fertility and reducing the rate of population growth. Government programs and policies could make specific contributions by strengthening the incentives and improving the opportunities for women to find employment outside of the home, in fostering more universal school attendance, and by allocating more resources to health and welfare programs that seek primarily to eliminate the causes of infant and child mortality.

III. INTERNAL MIGRATION RATES

MEASUREMENT OF MIGRATION

A migration rate is defined as the ratio of a net migration flow to local average population size. If the observation time period is short, deaths, births, and migration are small relative to the base population and the measurement of a migration rate presents no particular problems. However, when the time interval is longer, as in Colombia where 13 years have elapsed between censuses and the registration of births and deaths is incomplete, a number of assumptions are required to estimate regional migration rates.[1]

Sex and region specific migration rates are estimated for each five year age cohort in 1951 between the ages of 0 and 44.[2] The estimated migration rates examined here do not necessarily add up to zero for all observations, since they are unweighted averages of municipality migration rates, and moreover the sample of municipalities, for various reasons, is not always representative of the entire Colombian population.[3] Thus, the findings pertain to the municipal average tendency for migration to occur among different age and sex groups in the various regions of Colombia.

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[1] Basically the national regime of mortality was estimated from various demographic sources. These age and sex specific death rates are then applied for 13 years to the age and sex specific population enumerated in each region in 1951. The difference between this "no-migration estimate" and the number of persons enumerated in that region in the 1964 Census is defined as in- or out-migration. The continuously compounded migration rate is then calculated that would have yielded the estimated amount of in- or out-migration. For a detailed consideration of this procedure see Part II of Appendix B.

[2] Without information on the exact number of births between the censuses it is not possible to estimate the migration among individuals less than 13 years old in 1964 who were not born at the time of the 1951 census. It was judged that age misreporting became a serious enough problem after the age of 50 not to warrant the computation of migration rates beyond the cohort aged 40-44 in 1951 that had attained the age of 53-57 by 1964. The youngest and oldest age cohort migration rates are, probably, the least reliable.

[3] See Part I of Appendix B for discussion of characteristics of the Colombian sample.

ESTIMATES OF MIGRATION RATES FROM SAMPLE

The average annual migration rate estimates are summarized in Tables 5 through 9 for various components of the sampled population. Age specific migration rates are first computed for the cohort age 0 to 44 in 1951 which had obtained the age of 13 to 57 by the time of the 1964 census of population. Since it is not generally possible to discern at what age migration takes place during this period, nor indeed whether the rate of migration increased or decreased in the interim, it is convenient for our purposes to refer to this cohort by their ages (7 to 51) in 1958 at about the middle of the observation period. Migration rates are presented for the entire municipality as well as for its urban component, the municipal administrative center or Cabecera, and for the rural regions outside the Cabecera. Since many of the municipalities have only a small Cabecera, those greater than 10,000 are singled out for special consideration as large towns. From the total of 131 municipalities sampled, 17 qualify by this criterion as containing a large Cabecera and accordingly called predominantly urban. This two-way division of the sample underlies the findings shown in Tables 5, 7 and 8. Age cohorts are distinguished by five year intervals in Tables 6 through 8 to present a more precise picture of the age, sex, and regional composition of migration and summarized in Table 9. From these results a number of characteristics of the migration process in Colombia may be noted.

Regional Distribution of Migration

On balance the cities, with populations in excess of 10,000 in 1964, gained greatly from migration, although even in this group of the 17 towns sampled there are several exceptions (Table 5). In the age group 7 to 51 (in 1958) men migrated into the cities at an annual rate of 1.5 percent and women at 2.0 percent. For the towns (Cabeceras of less than 10,000), men migrated out at an annual rate of 1.2 percent and women at a slower .6 percent. The sex composition among migrants out of the rural regions was more nearly balanced, with men leaving at a rate of 3.0 percent per year and the women at 3.1 percent

Table 5

ANNUAL AVERAGE MIGRATION RATE FOR MEN AND WOMEN 1951-1967
FOR MUNICIPALITIES WITH CITY OF 10,000 OR MORE INHABITANTS[a]
(in percent)

Name of Municipality	Total Municipality		Cabeceras (County Seat)		Other (Rural) Areas	
	Male	Female	Male	Female	Male	Female
Sonson	-4.17	-3.55	-.84	.16	-5.62	-5.76
Baranoa	.07	.37	.52	.90	-1.42	-1.68
Soledad	.94	1.71	1.07	1.80	-3.33	-2.35
Corozal	-1.22	-.63	.88	1.54	-2.02	-1.72
Turbaco	-1.62	-1.28	-.95	-.83	-5.09	-4.34
Santander	-.12	.11	2.21	2.16	-1.09	-.94
Monteria[b]	-.34	.61	4.94	5.13	-4.16	-3.80
Cerete	.53	1.20	1.17	2.30	.13	.32
Sahagun	-4.03	-3.61	.96	1.84	-5.15	-5.52
Fusagasuga	-.08	.23	3.03	3.18	-3.32	-3.97
El Cerrito	-1.72	-.47	4.24	3.98	-5.79	-4.93
Palmira[b]	1.37	1.91	2.56	2.80	-1.34	-.97
Pradera	-1.44	-1.18	2.06	1.67	-4.19	-4.37
Aguadas	-2.27	-2.13	-1.56	-.37	-2.55	-2.98
Chinchina	-.55	.22	1.77	2.95	-2.65	-3.51
Santa Marta[b]	3.29	3.08	3.94	3.82	.43	-1.25
El Banco	-.94	-.33	-.42	.35	-1.41	-1.18
Average of municipalities with city of 10,000 or more	-.72	-.22	1.50	1.96	-2.86	-2.88
Average of all municipalities in sample	-2.41	-2.14	-.82	-.23	-3.10	-3.10

Notes:

[a]Age 0-44 to 13-57.

[b]These municipalities have a Cabecera population in excess of 40,000: Monteria, 70,531; Palmira, 106,502; Santa Marta, 89,161, in 1964 Census (see Table B-2).

Source:

See Methodology in Appendix B.

Table 6

ANNUAL AVERAGE MIGRATION RATES BY AGE AND SEX FOR A REPRESENTATIVE SAMPLE OF COLOMBIAN MUNICIPALITIES, 1951-1964
(Sample Size 131)
(percent of age cohort from 1951 to 1964)

Region Analyzed	0-4 13-17	5-9 18-22	10-14 23-27	15-19 28-32	20-24 33-37	25-29 38-42	30-34 43-47	35-39 48-52	40-44 53-57	0-44 13-57
Total municipality										
Male	-1.509	-3.247	-3.744	-2.294	-1.959	-1.089	-1.002	-1.294	-1.090	-2.410
Female	-1.648	-2.660	-2.607	-2.100	-1.776	-1.618	-1.117	-2.276	-1.903	-2.139
Both sexes	-1.585	-2.945	-3.165	-2.195	-1.889	-1.374	-1.071	-1.791	-1.500	-2.246
Cabeceras (urban)										
Male	.241	-2.115	-2.648	.572	.726	.931	.917	.800	.779	-.817
Female	1.633	.046	-1.357	-.827	-.372	.111	.572	-.517	.047	-.232
Both sexes	1.003	-.928	-1.952	-.222	.040	.449	.686	.067	.316	-.381
Other areas (rural)										
Male	-2.111	-3.742	-4.206	-3.078	-2.698	-1.730	-1.649	-2.045	-1.819	-3.089
Female	-3.004	-3.824	-3.130	-2.629	-2.428	-2.439	-1.960	-3.205	-2.885	-3.103
Both sexes	-2.592	-3.774	-3.680	-2.854	-2.596	-2.094	-1.806	-2.595	-2.315	-3.099

Source:
See Methodology in Appendix B.

Table 7

ANNUAL AVERAGE MIGRATION RATES BY AGE AND SEX FOR SAMPLE OF PREDOMINANTLY RURAL MUNICIPALITIES OF COLOMBIA, 1951-1964
(Sample Size 114)
(percent of age cohort from 1951 to 1964)

Region Analyzed	0-4 13-17	5-9 18-22	10-14 23-27	15-19 28-32	20-24 33-37	25-29 38-42	30-34 43-47	35-39 48-52	40-44 53-57	0-44 13-57
Total municipality										
Male	-1.738	-3.598	-4.067	-2.549	-2.090	-1.232	-1.117	-1.442	-1.217	-2.662
Female	-1.986	-3.086	-2.967	-2.329	-1.907	-1.778	-1.280	-2.445	-2.118	-2.425
Both sexes	-1.870	-3.335	-3.507	-2.437	-2.020	-1.525	-1.210	-1.948	-1.672	-2.513
Cabeceras (urban)										
Male	.084	-2.619	-3.037	.391	.581	.701	.730	.603	.593	-1.163
Female	1.275	-.428	-1.794	-1.090	-.576	-.097	.386	-.678	-.147	-.559
Both sexes	.666	-1.414	-2.370	-.449	-.149	.231	.495	-.113	.115	-.706
Other areas										
Male	-2.104	-3.844	-4.329	-3.163	-2.640	-1.678	-1.567	-1.984	-1.747	-3.134
Female	-3.022	-3.936	-3.283	-2.689	-2.332	-2.372	-1.893	-3.182	-2.788	-3.136
Both sexes	-2.604	-3.880	-3.810	-2.926	-2.520	-2.040	-1.731	-2.552	-2.283	-3.135

Source:
See Methodology in Appendix B.

Table 8

ANNUAL AVERAGE MIGRATION RATES BY AGE AND SEX FOR SAMPLE OF PREDOMINANTLY URBAN MUNICIPALITIES OF COLOMBIA, 1951-1964
(Sample Size 17)
(percent of age cohort from 1951 to 1964)

Region Analyzed	0-4 13-17	5-9 18-22	10-14 23-27	15-19 28-32	20-24 33-37	25-29 38-42	30-34 43-47	35-39 48-52	40-44 53-57	0-44 13-57
Total municipality										
Male	.029	-.893	-1.580	-.580	-1.081	-.128	-.227	-.295	-.244	-.723
Female	.623	.200	-.198	-.561	-.896	-.548	-.021	-1.139	-.458	-.220
Both sexes	.328	-.332	-.870	-.572	-1.012	-.363	-.141	-.733	-.347	-.457
Cabeceras (urban)										
Male	2.421	1.265	-.040	1.785	1.699	2.470	2.174	2.118	2.029	1.505
Female	4.037	3.224	1.572	.937	.994	1.507	1.815	.562	1.346	1.962
Both sexes	3.265	2.329	.846	1.303	1.302	1.915	1.974	1.261	1.659	1.799
Other areas (rural)										
Male	-2.158	-3.058	-3.380	-2.510	-3.086	-2.076	-2.202	-2.452	-2.299	-2.857
Female	-2.888	-3.074	-2.174	-2.224	-3.069	-2.892	-2.411	-3.359	-2.925	-2.880
Both sexes	-2.506	-3.063	-2.813	-2.374	-3.100	-2.456	-2.304	-2.889	-2.534	-2.862

Source:
See Methodology in Appendix B.

Table 9

SUMMARY OF ANNUAL AVERAGE MIGRATION RATES BY AGE AND SEX
FOR A REPRESENTATIVE SAMPLE OF COLOMBIAN MUNICIPALITIES
(percent of average age cohort between 1951 and 1964)

Region and Sex (Sample Size)	Age Cohort in 1951 and 1964									
	0-4 13-17	5-9 18-22	10-14 23-27	15-19 28-32	20-24 33-37	25-29 38-42	30-34 43-47	35-39 48-52	40-44 53-57	0-44 13-57
1. Cities: Cabeceras greater than 10,000 (17)										
Male	2.42	1.27	-.04	1.79	1.70	2.47	2.17	2.12	2.03	1.51
Female	4.04	3.22	1.57	.94	.99	1.51	1.82	.56	1.35	1.96
Both sexes	3.27	2.33	.85	1.30	1.30	1.92	1.97	1.26	1.66	1.80
2. Towns: Cabeceras less than 10,000 (114)										
Male	.08	-2.62	-3.04	.39	.58	.70	.73	.60	.59	-1.16
Female	1.28	-.43	-1.79	-1.09	-.58	-.10	.39	-.68	-.15	-.56
Both sexes	.67	-1.41	-2.37	.45	-.15	.23	.50	-.11	.12	-.71
3. Countryside: Rural areas outside of all Cabeceras (131)										
Male	-2.11	-3.74	-4.21	-3.08	-2.70	-1.73	-1.65	-2.05	-1.82	-3.09
Female	-3.00	-3.82	-3.13	-2.63	-2.43	-2.44	-1.96	-3.21	-2.89	-3.10
Both sexes	-2.59	-3.77	-3.68	-2.85	-2.60	-2.09	-1.81	-2.60	-2.32	-3.10

Note:
A negative migration rate means a net out-migration from the region, and conversely for a positive migration rate. A sample of 131 municipalities (about 15 percent) of Colombia was drawn randomly from those for which 1951 and 1964 census data were available on a comparable basis. Cohort survival probabilities were estimates for the country as a whole and assumed to pertain to each municipal population in order to compute compounded average annual migration rates for each age and sex cohort. The table shows unweighted averages of the specific migration rate from the sample, and need not equal zero for the entire sample.

Source:
Tables 6, 7, and 8.

per year. Viewing the sample as a whole, the municipalities lost each year, on the average, 2.4 percent of the men between the active ages of 7 and 51 and 2.1 percent of the women. The limitations of the census data and the consequent method of constructing the sample are later seen to explain the character and magnitude of this net outflow of persons from the sampled municipalities.[1]

Sex Selectivity

Rural out-migration is not markedly sex selective, but urban in-migration is somewhat selective of women. Where then do the remaining men go? Two regions are underrepresented in the Colombian sample: the larger cities which receive equal weight in our sample with less populous rural municipalities, in particular Bogota, and the frontier territories for which census data are not compiled in 1951 and 1964 on a comparable basis, and therefore excluded from the sample frame. The frontier regions excluded from the sample contained 3.4 percent of the Colombian population in 1951 and 4.2 percent in 1964. Evidence from Bogota and other large cities suggests that more women than men migrate into the metropolitan centers, and thus this flow does not explain the slight preponderance of men migrating out of the sampled regions. The frontier territories, however, contain more men than women, and the population in these areas has grown more rapidly in the active age groups than can be explained without resort to large in-migration. The sex ratio for the regions included and excluded in the national sample are shown in Table 10, and they suggest the countervailing sex imbalances in the cities and frontier territories of Colombia that undoubtedly reflect the effects of past migration.[2] Thus, in summary,

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[1] These are unweighted averages of municipal migration rates. The averages need not, therefore, approximate an aggregate migration rate for the sampled regions. A two percent inflow of migrants into a large city dominated municipality would exactly counterbalance a 2 percent outflow from a small rural municipality. The number of persons entering the city would nevertheless vastly exceed the number leaving the rural region.

[2] The sex imbalance increases to 125 men to 100 women when one considers only the frontier Amazon regions, namely, Meta, Aranca, Caqueta, Amazonas, Guinia, Putamavo, Vaupes, and Cichada.

Table 10

NUMBER OF MEN FOR EACH HUNDRED WOMEN BY REGION IN COLOMBIA, 1964 CENSUS

Region	Total Municipality	Cabeceras (urban)	Other Areas (rural)
Established Departments from which municipal sample drawn	96.8	88.2	107.4
of which Bogota D.E. (metropolitan area)	87.5	87.3	95.1
Frontier regions not represented in municipal sample	105.5	94.2	111.1
All of Colombia	97.1	88.4	107.6

Source:
Bolletin Mensual de Estadistica, May 1967, No. 194, p. 12 ff.

migration from established rural regions of Colombia to the frontier agricultural regions is strongly male selective, whereas migration from the countryside to the cities is slightly female selective. Other evidence on migration from other periods and places has often revealed parallel patterns of sex selectivity when open frontiers and urbanization provide alternative goals for the migrant.[1]

Age Selectivity

For many and obvious reasons, migration is age selective, drawing forth young, able-bodied, and unencumbered workers. The highest age specific migration rates occur for men who were between the ages of 17 and 25 in 1958. Until age 37-41, migration rates for men decrease, and thereafter stabilize or perhaps increase slightly. Among women, fluctuations in age specific migration rates are less than among men, they reach their peak at a younger age, between 12 and 16, decline gradually until age 37 to 41 and then rise again.[2] For women to migrate earlier is plausible, for once married or with children their mobility is reduced.[3] With the relatively high level of mortality in Colombia, a substantial proportion of women are widowed by age 40, and this may contribute to the increase of out-migration of women from rural areas after they reach age 40.

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[1] See for example, H. T. Eldridge and D. S. Thomas, Population Redistribution and Economic Growth, United States, 1870-1950, Vol. III, Demographic Analyses and Interrelations, American Philosophical Society, Philadelphia, Pennsylvania, 1964, Chapters VI and VII in particular. Without frontiers England in the 19th century reveals the predominance of women migrating from agricultural-rural regions to the cities, as first observed by E. G. Ravenstein, "The Laws of Migration," Journal of the Royal Statistical Society (U.K.), Vol. 48, June 1885, and Vol. 52, June 1889. For other evidence of this pattern in Latin America see T. P. Schultz, "Demographic Conditions of Economic Development in Latin America," in Latin America: Problems in Economic Development, New York, Free Press of Glencoe, 1969.

[2] A similar pattern is noted in U.S. migration data. See Eldridge and Thomas, Chapter VI, pp. 131-192.

[3] Caldwell also finds evidence of this pattern in Ghana. J. C. Caldwell, "Determinants of Rural-Urban Migration in Ghana," Population Studies, Vol. 22, No. 3, November 1968.

Between urban and rural regions of the municipalities the age/sex patterns of migration are similar to those estimated for the entire municipality. In the towns and cities the outflow of men is concentrated in the age cohorts 12 to 16 and 17 to 21, and thereafter men on balance migrate in. Women leave the towns later than they do the rural regions; town out-migration rates reach a maximum for those aged 17 to 21. This could be due to later marriage, and greater opportunity for women to attend schools and find employment in urban areas compared with rural ones. In the rural areas women tend to migrate out of the community more often than men at older ages; at these ages they may be less tied than men to agriculture by their vocational skills.[1]

The towns lose many of their young men and a few women at all ages, but attract older men who are probably displaced from traditional agricultural and rural craft occupations. The cities draw men and women in large numbers, women mostly at young ages and men somewhat more often at older ages. One may infer from various evidence that some of the young men leaving established rural regions are making their way to the frontier territories while the majority, of course, migrate to the cities. On the other hand, women of all ages are gravitating predominantly to the big cities where their services are most in demand.

This review of the general flows of migration in Colombia prepares us in the next section to develop an explicit framework for interpreting migration rates primarily as a response to disequilibrium in the local labor markets. Since the migration rates estimated for the rural population are greater and more uniform across age and sex cohorts than those estimated for the towns and cities, it is this rural exodus that dominates the migration rates estimated at the municipal level. The identification of the economic, social, and political forces that account for these high rates of out-migration from the rural Colombian population is the objective of the next section.

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[1] Housekeeper skills are more in demand in the urban environment than the rural one, and may require less youthful flexibility for a woman to learn these skills at middle age, than for a man to acquire a new trade.

IV. A MODEL OF INTERREGIONAL MIGRATION

INTRODUCTION

The roots of internal migration in the development process are obscure and difficult to weigh in the design of policy. Yet control or effective management of migration first requires knowledge of these causes. A commonly accepted test of knowledge is the ability to predict the phenomenon satisfactorily. This section brings together, within the data limitations for Colombia, elements of an economic model of migration. Section V examines the power of this model to predict differences in migration rates across a sample of Colombian municipalities, and estimates the responsiveness of migration to various forces.

The hallmark of the development process is disequilibrium in which the returns to comparable factors are no longer equal. Regional labor markets are perhaps the most common example of disequilibrium in factor markets, and many simple formulations of the economic development process pivot on precisely this immobility of factors between agriculture and industry. Migration flows, such as are occurring in Colombia, are to be understood in the context of a disequilibrium model, adjusting toward, but still far from achieving, equilibrium among the network of interrelated factor markets. From an economic standpoint, interregional migration rates are here interpreted as adjusting flows that respond to the degree of disequilibrium among regional labor markets. The recent widening of regional disequilibria may be traced back to the uneven regional expansion of population or economic opportunities, or both.

This general equilibrium approach to internal migration requires the specification and estimation of both the regional supplies of labor and the regional derived demands for labor. Though the potential supply of labor in a region is approximately determined in the short run by the age and sex composition of the population (and further information, such as fertility), our analytical understanding of the nature of heterogeneous regional production functions will not suffice to estimate

relationships for the derived demand for labor. Even with the simplified view of the migration process adopted here to satisfy Colombian data limitations one nevertheless encounters the same difficulty in specifying and measuring adequately the sources of shifts in the regional derived demand for labor.

The Model

Regional populations are initially assumed to be composed of identical individuals. The propensity of any individual to migrate from one region to another in a specified period of time is assumed to be a function of the migrant's knowledge of the economic and social attractiveness of the two locations, and is further conditioned by the relevant costs of migration.[1] Economically, the current and expected employment opportunities in a locality and abroad are the central determinants of a person's propensity to migrate, where opportunities are broadly interpreted in three categories: wages, risk of unemployment, and non-wage benefits. A further factor peculiar to Colombia is the prevalence of rural violence, which may motivate persons to leave the countryside in search of greater security in towns and cities.[2] Abstracting for the moment from problems of measurement

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[1] If interregional migration is to be analyzed as a stochastic process for which the parameters can be estimated by ordinary regression analysis, there are powerful reasons to define the dependent variable, migration, as a population rate or average propensity rather than as an absolute number (of migrants). This procedure first provides a clear link between the aggregate estimated model and the underlying rationale of individual behavior. But also this specification of the dependent variable as a rate rather than an absolute number corrects for serious sources of bias and inefficiency in the estimating procedure that are introduced by the unequal size of regional populations and their frequent association with other social and economic determinants of the migration process itself.

[2] Organized rural violence in Colombia, La Violencia, along regional, class, and political lines claimed the lives of an estimated 200,000 persons during the 1950s. It is alleged that this destructive and pervasive reign of violence in the countryside contributed to the rapid rural-urban migration. In the department of Tolima, for example, it is claimed that 42 percent of the residents were forced to leave their homes to escape the widespread violence. Whatever are the social,

and aggregation, it is assumed an average value of these environmental variables is appropriate in accounting for differences in migration rates (average propensity to migrate) among comparable regional populations. Symbolically, the migration rate may then be expressed:

$$M_i/P_i = f(w_i, w_j, W_i^*, U_i/P_i, nw_i, C_{ij}, V_i/P_i), \qquad (1)$$

where M_i/P_i is the migration rate for the local i^{th} region's population, greater than zero if there is net in-migration, and less than zero if there is net out-migration.

w_i is the local wage rate

w_j is the (manufacturing) wage rate in the nearest major city

W_i^* is the expected local wage

U_i/P_i is the local unemployment rate per capita

nw_i is the local non-wage benefits

C_{ij} is the cost of migrating from the locality (i) to the nearest city (j)

V_i/P_i is the frequency of violence in the locality.

This formulation of the migration process is in part dictated by the availability of Colombian data. Since some of these data are not likely to be relevant to most persons who might consider migration, a simpler form of the model is developed later. The above specification of the model implies that the migrant has several sources of

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political, or economic roots of this malaise it must be considered in amy comprehensive explanation of postwar regional migration rates. The classic study of this phenomenon is German Guzman, Fals Borda, and Eduardo Umana, La Violencia en Colombia, Monografias Sociological, Vol. 1, No. 12, National University, Bogota, 1962; and Ediciones Tercer Mundo, Bogota, 1964, Vol. 2. For a discussion in English, see Robert C. Williamson, "Toward a Theory of Political Violence: The Case of Rural Colombia," Western Political Quarterly, Vol. 18, No. 1, March 1965, pp. 35-44; and R. S. Weinert, "Violence in Pre-modern Societies: Rural Colombia," American Political Science Review, Vol. 60, No. 2, June 1966, pp. 340-347.

information on current and expected local opportunities, but relies for his information on opportunities elsewhere solely on the (manufacturing) wage paid in the nearest of six major cities.[1] Although the mountainous terrain of Colombia to some extent contains and focuses the flows of internal migration within each of the six watersheds, a more satisfactory specification of migration would include the migrant's evaluation of opportunities in all regions of the country. This study is based on an analysis of a 15 percent sample of municipalities, which precludes a comprehensive search of alternative rural employment opportunities, and regrettably little other systematic information is available on labor market conditions in the important towns, cities, and frontier settlements.[2]

Slighton's study of the structure and evolution of the Colombian urban labor market gives us some insights into urban duality. There appear to be two equally large parts to the urban labor force in Colombia: one employed by a modern class of industries for which real wages and output per worker have increased annually from 1951 to 1964 by 4 percent, and the other working in a traditional class of sectors characterized as "craft" for which real wages and output have not increased notably.[3] The same dichotomy may be seen in

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[1] Implicit in this formulation is the assumption that the wage in this nearby city is a sufficient indication of the attractions of the metropolitan area, and differences among cities in unemployment rates and non-wage benefits do not differentially affect the migration rates in the watersheds of various cities. Slighton's study of the urban labor market in Colombia suggests that short-run fluctuations in urban employment opportunities may play a role in determining the timing of urban in-migration, but here it is assumed that over the 13 years analyzed the differences in average unemployment and non-wage benefits balance out among the six cities, or if not, they have directly affected the wage structure among cities. R. L. Slighton, Urban Unemployment in Colombia: Measurement, Characteristics, and Policy Problems, RM-5393-AID, January 1968.

[2] See Appendix B for a discussion of the sample.

[3] R. L. Slighton, Relative Wages, Skill Shortages, and Changes in Income Distribution in Colombia, RM-5651-RC/AID, November 1968.

Colombian agriculture.[1] The manufacturing wage series for six Colombian cities that is used here represents sample survey estimates of wage developments in the modern, large scale, urban manufacturing portion of the labor market. The migrant, however, is likely to be confined, at least initially, by his lack of urban skills and education to the traditional sector where real wages have stagnated. Thus, there is reason to believe that there will be no necessary relationship between changes in observed manufacturing wages and changes in real employment opportunities for migrant labor within Colombian cities. The lack of comprehensive data on employment opportunities and the doubtful importance of manufacturing wage rates to the migrant lead us to consider an alternative model of the migration process.

This model abstracts from the region's location vis-à-vis major urban centers. This simplification is more justifiable if migrants were indifferent to the distance traveled, once uprooted from their local community, and the pecuniary costs of lower-class transportation were negligible. Then a person's propensity to migrate from his rural community to the city becomes largely independent of his initial location.[2] Though rural out-migration continues to be a function implicitly of the employment opportunities in all cities, it is not responsive to the differential advantages offered by the nearest city. If this simplified conception of the migration process were realistic, local employment opportunities would be more important in accounting for interregional differences in migration rates than would nearness to urban centers or the prosperity of just the modern manufacturing sector in those centers.

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[1]This implication is derived from the urban and rural sample data on wages and income for Colombia in Appendix B; in particular see Tables B-4 and B-5.

[2]Although land transportation across the mountain divides in Colombia remains difficult except in a few places, the network of government subsidized bus lines reaches into virtually every inhabited valley and most highland communities.

EXPECTED WAGE: AGRICULTURAL DERIVED DEMAND FOR LABOR

Because the scope of the market for day labor may be thin in some regions of Colombia and not accurately represent the local returns of average quality labor, and the magnitude of disequilibrium in local labor markets may depress current wages substantially below the level workers continue to expect in the future, some method for estimating the expected local wage should be explored as a supplementary determinant to migration.[1] From any plausible production function for agriculture, the marginal productivity of labor and hence a measure of the equilibrium long-run competitive wage is an increasing function of the supplies of complementary factors of production per worker: land and capital. It is also probable that factor proportions or the labor intensity of agricultural production in Colombia differs depending on the regional land tenure arrangements.[2] The expected

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[1] Though the daily wage in agriculture may correspond with the productivity of the least skilled (marginal) worker, it is not always this marginal worker who migrates. Indeed, a variety of evidence suggests that the better educated migrate in disproportionate numbers from rural to urban areas. It may therefore be appropriate to consider an estimate of the average wage that would include some of the returns to skilled and experienced labor in the region, and it is here assumed that this skill premium would be a function of the supplies of cooperating factors of production in the region.

[2] Much of the better land in Colombia is given over to raising cattle, for which the labor requirements are alleged to be small. In contrast, small holders and tenants are assumed to employ much more labor per unit of land. Thus the prevalence of small tenant holders may indicate higher long-run elasticity of demand for labor and the predominance of labor intensive forms of agricultural production. Moreover, large agricultural operations are bound to pay minimum wages and meet fringe benefits spelled out in the labor code while they conversely have often had attractive opportunities to import modern agricultural implements and producer capital goods (at least during the early 1950s when coffee prices were high and foreign exchange abundant). These distortions in relative factor prices facing large agricultural operations in Colombia may have spurred labor saving, and thus reduced labor demand in this commercial sector of agriculture still further during the period 1951 to 1964. Capital gains of farmers may be important, as argued by Johnson, and would tend to retard rural-urban migration among landowners but not among tenants. D. Gale Johnson, "Efficiency and Welfare Implications of U.S. Agricultural Policy," Journal of Farm Economics, Vol. 45, No. 2, May 1963, pp. 338-348.

regional wage is, therefore, believed to be a function of three difficult to measure variables: the land to man, capital to man ratios, and the land tenure arrangements.

$$W_i^* = g(L_i/P_i', K_i/P_i', D_i) \qquad (2)$$

where L_i/P_i' is the land to man ratio in the region in 1960.

K_i/P_i' is the capital to man ratio in the region in 1960.

D_i is the proportion of arable land farmed by tenants in the region in 1960.

UNEMPLOYMENT: POPULATION GROWTH

Unemployment is interpreted as a frictional phenomenon resulting from unequal rates of change in the supplies of cooperating factors of production, assuming constant returns to scale and factor neutrality of technical change. Current unemployment is then a function of the initial level of unemployment, and the subsequent rates of change in factor supplies: land, capital, and population or potential labor supply.

$$U_i/P_i = h\left((U_i/P_i)_o, \frac{\Delta L_i}{L_i}, \frac{\Delta K_i}{K_i}, \frac{\Delta P_i}{P_i} \right) \qquad (3)$$

Unfortunately, many of these variables are not observed in Colombia. In Eq. (3) only the rate of change in population is estimable, for the single Agricultural Census of 1960 provides but one benchmark estimate of the stocks of land and capital. Unemployment, moreover, is unreliably measured in the rural sector and almost by definition incomparable between urban and rural sectors of a less developed country. Therefore, unemployment is simply expressed as a function of the rate of change in the potential labor force (population growth without regional migration). Substituting Eqs. (3) and (2) into (1), an expression for the regional migration rate is obtained, which is assumed to be approximately linear for the purposes of estimation.

$$M_i/P_i = f\left(w_i, w_j, \frac{K_i}{P_i'}, \frac{L_i}{P_i'}, \frac{\Delta P}{P_i}, nw_i, c_{ij}, \frac{V_i}{P_i}\right) \qquad (4)$$

IS MIGRATION HOMOGENEOUS?

There are several implications and limitations of this characterization of the migration process. First, particular groups may be more susceptible to migration opportunities: The young, who are still relatively unencumbered and look forward to many rewarding years in a new location; the better educated, who are equipped to evaluate the opportunities and uncertainties abroad; and the women, who often have more to gain from leaving traditional rural society and accepting the responsibilities of progressive urban society. To the extent that the composition of regional populations differ with regard to age, sex balance, and educational attainment, one might expect them to differ in their susceptibility to migration given the same overall opportunities. Conversely, these different groups in the population may respond very differently to the various determinants of migration, as for example, violence or wage rates. It was shown in the previous section that rural-urban migration in Colombia is distinctly age and sex and region selective, which though broadly consistent with economic logic and empirical studies of migration in other parts of the world has not to our knowledge been disaggregated and examined in a predictive model.[1]

The second limitation of this specification of the migration process is that it neglects the "quality" of migrants. Our model implies that a single numerical measure of the net migration flow is a satisfactory reflection of the quantity of labor services responding to interregional labor market disequilibria.

There are two general methods for coping with the compositional selectivity of migration or the differences in responsiveness of different groups of potential migrants. One is to examine subpopulations that are more homogeneous with respect to the particular characteristics.

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[1] For a review of the economic logic, see L. Sjaastad, "The Costs and Returns of Human Migration," in Investment in Human Beings, Supplement to The Journal of Political Economy, Vol. 70, No. 5, pt. 2, October 1962.

Accordingly, 36 groups are distinguished by age, sex, and rural-urban residence and analyzed separately as well as combined into various population aggregates. It is not possible, however, to control for educational attainment by computing education specific migration rates, for the necessary information on the educational attainment of the municipal populations was not published for the 1951 Census. A second method for controlling for the influence of education on migration is to construct an aggregate measure of educational attainment in the community, and interpret this variable as a determinant of the locality's migration rate.

Education may, however, influence the rate of migration in at least two countervailing directions. A municipality that schools a large proportion of its child population provides a free service which may be valued highly by local residents. This public service or non-wage benefit adds to the attractiveness of the locality to a potential migrant.

On the other hand, children who are educated are more likely to migrate once they are economically independent of their parents. Migration tends to be selective of the better educated, probably because the educated can evaluate their opportunities outside the local labor market, and they tend to be more adaptable to the demands placed on the migrant. Also, the financial returns to migration appear to be higher for the educated person than for the unschooled.

Evidence from Bogota suggests the returns to primary, secondary, and vocational schooling are substantial, and the migrant appears to receive no less for his services than a native born resident of Bogota of the same sex, age, and educational attainment.[1] Not only is the level of rural wages much below those observed in major cities, but there is evidence that schooling is valued less highly in rural than in urban activities. Consequently, the relative and absolute differences in income between rural and urban labor markets are greater for the educated than for the uneducated,[2] and the returns to migration

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[1] T. Paul Schultz, Returns to Education in Bogota, Colombia, RM-5645-RC/AID, The RAND Corporation, September 1968, p. 21.

[2] See income data for 1965-1966 in Appendix Tables B-6 and B-7.

are therefore higher for persons with more schooling.[1]

The second assumption implied in this model is that a certain level of migration is associated with a uniform (constant quality) flow of labor services adjusting to regional labor market disequilibria. Though the differences in labor force participation are substantially controlled for by considering migration rates by age, sex, and region specific groups, there still remains the elusive quality dimension of the labor flow. How much should we worry about the possibility of various streams of migration, each having particular skills and labor force attributes, being submerged in net migration rates?

It seems probable, as argued by Sjaastad, that interregional migration in an industrially developed and mobile economy, such as the United States, should be characterized as heterogeneous, for different concurrent interregional migration flows contain very different human capital components and respond to various special market inducements.[2] The more nearly unidirectional net flow of migrants in Colombia, from established agricultural regions and small towns to the cities, does

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[1]This raises the rate of return formulation of the migration process as an investment activity undertaken when discounted benefits sufficiently outweigh the associated costs. But as a formal predictive model this human capital framework for analyzing migration places great demands on the data base, requiring information on future earning profiles for individuals in a variety of locations and direct and opportunity costs associated with moving from one location to another. Largely for this reason, I suspect, the basic hypothesis of this approach, that migration occurs in response to the rate of return, has not yet been rigorously tested. Were information available on alternative labor market opportunities and migration costs, one could solve for a pecuniary rate of return to migration among all alternative environments and add this predictive variable to the model. This single variable would, nevertheless, neglect the effects of uncertainty, imperfect capital markets, the cost of information, and non-pecuniary costs and benefits associated with migration. Since even the pecuniary rate of return cannot be calculated from available data, we are compelled to turn to proxies for the intermediate variables that determine the pecuniary rate of return: wages, unemployment, and the costs of migration. See L. Sjaastad, "The Costs and Returns of Human Migration."

[2]Ibid.

not in all probability conceal deep cross-currents of skill specific migration. Indeed, the skills of the migrant from the rural sector are probably not so specialized that they could fruitfully be analyzed in a heterogeneous labor model, even if data were available. Consequently, in developing countries such as Colombia where heavy net migration follows the traditional course from countryside to city and specialized talents are relatively unimportant, it is probably acceptable to treat labor in a migration model as homogeneous within age and sex cohorts.

An additional problem of estimating Eq. (4) arises from the probable simultaneous determination of several of the "exogenous" variables. The frequency of violence and the growth of potential labor force, both of which foster out-migration, may not be predetermined, but may be rather influenced simultaneously by the economic attributes of the local environment and its population. Though the current rate of entry into the labor force that influences current migration is largely determined ten to twenty years earlier by the parents' environment, this prior environment is not strictly independent of the current environment, which is also observed to be associated with migration. Without a deeper knowledge of the underlying causes of the rural violence, and information on the earlier regional environment, simultaneous estimation of these three relationships is not feasible.[1]

DATA FOR ESTIMATING THE MIGRATION MODEL

According to our estimation of the real daily wages paid to agricultural labor in Colombia, this wage did not increase significantly from about 1952 to 1965, whereas the real wage paid in the urban manufacturing sector sampled by DANE increased in real terms between 3 and 4 percent per year.[2] Change in the relative price of food in rural

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[1] Appendix C briefly explores the evidence on the causes of the rural violence, and shows what environmental factors are associated with this phenomenon.

[2] The Departamento Administrativo Nacional de Estadistica (DANE) publishes the results of its manufacturing survey on an annual basis

and urban markets appears to be responsible for part of this relative deterioration in the rural wage. Three formulations of the wage variable are used in investigating the causes of regional migration: (1) the absolute difference between the money wage in 1956 in the rural region and the wage in the nearest of the six cities for which manufacturing wage and consumer price series are available; (2) the rural daily wage in 1956 including the provision of food by the employer; and (3) the difference in the annual average growth of real wages (1952-1965) in the rural and nearest urban manufacturing center.

The factor supplies in agriculture cannot be derived from the 1960 Census of Agriculture in common value terms. In the diverse terrain of Colombia, arable land per capita is only a very crude proxy for the value of the land's services with which labor might be productively employed. Nevertheless this variable is used here to represent the value of land available per person in agriculture. The capital stock is also poorly specified, but given the choice of combining coffee trees, livestock, and tractors on an arbitrary basis, the simple ratio of tractors per capita is adopted as a rough measure of modern capital inputs into agriculture; inputs that might be labor saving, on balance. These measures of the inputs into agriculture are considered to be the weakest link in our empirical analysis.

The rate of growth of the labor force in the absence of migration cannot be directly computed from the excess of births over deaths. However, the ratio of surviving young children to the adult population can be estimated at the start of the migration period in 1951. This estimate of population pressure is converted to a proxy of the crude birth rate which appears to have been responsible for the observed age composition of the population.[1]

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in the Anuario General de Estadistica. The methodology or reliability of the survey estimates are not published. Other information on relative family incomes in rural and urban sectors of Colombia is presented in Appendix B, Tables B-6 and B-7.

[1] See Appendix B for a precise statement of the estimation method.

The costs of migration are complex, and probably psychic costs of adjustment are a more significant barrier to migration than a cheap, long bus ride from the country to the city. Furthermore, other econometric migration studies have found little evidence to support the hypothesis that distance per se was a prime determinant of migration.[1] Yet since it is often assumed that the distance of migration reflects the costs of the migration process, this hypothesis is tested here. Because the urban center is the main focus of migration, the distance between Cabecera and Department capital is examined as a factor possibly influencing the rate of migration. The terrain of Colombia is so varied and often impenetrable in the highlands that the measure of geographic distance was translated into time (in hours) required to travel the distance (by mule, bus, train, and so on). Moreover, since it is doubtful that travel costs are linearly related to time, the logarithm of time is proposed as the final proxy for the "cost" of migration from the municipality to the Department capital or another more accessible major city.[2]

Since it is not clear exactly how or when the educational process facilitates or retards migration, school attendance, educational attainment, and literacy rates are considered for various age and sex groups in each municipal population to determine how these dimensions of the educational process are associated with local migration rates.

The frequency of politically motivated homicide from 1958 to 1963 associated with La Violencia per 10,000 municipal inhabitants as enumerated in the 1964 Census represents the observed impact of violence. Though the geographic focus of violence may have shifted as it ebbed

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[1] William D. Diehl, "Farm-Nonfarm Migration in the Southeast: A Costs-Returns Analysis," Journal of Farm Economics, Vol. 48, No. 1, February 1966.

[2] For the estimates of time to travel from municipality to capital see Circunscripciones Electorales y Division Politico -- Administrativa De Colombia 1964, Registraducia Nacional del Estado Civil, Bogota, Colombia, 1964. Logarithms to the base 10 of travel time in hours are used in the study as the distance variable, and where in two cases the municipality was the Department capital the time was assumed to be .01 hours, there being no logarithm of zero.

in this final phase of La Violencia, these data are the best publicly available as a proxy for the local incidence of rural violence throughout the period 1951 to 1964.[1]

A number of additional characteristics of the sampled municipalities are examined for their association with migration rates, but no particular findings emerged: measures of secondary and higher education, labor force participation of men and women, prior in-migration into the community, urban or rural residency, and the adequacy of housing stock measured by persons per room. Some of these characteristics of the sample are summarized in Table B-8.

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[1]German Guzman, Orlando Fals Borda, and Eduardo Umana, La Violencia en Colombia, Vol. II, Table III, Appendix Chapter II, pp. 301-325.

V. REGRESSION FINDINGS AND CONCLUSIONS

This section presents and discusses the regression findings of our investigation of interregional migration in Colombia. Least squares estimates of the linear approximation of Eq. (4) are computed for a sample of 131 municipalities.[1] First the migration model is estimated for migration rates based on the entire municipal population less than 44 years of age in 1951, and then reestimated for age, sex, and region specific migration flows.

AGGREGATE MIGRATION

The first five variables considered in regression 1, Table 11, are related in the postulated fashion with overall migration rates: high local wages reduce out-migration; schooling for young children restrains out-migration, but for older potential migrants, schooling is associated with higher out-migration; population pressure or our proxy for the natural rate of increase in the population accelerates out-migration; and the prevalence of violence also adds further to the outflow. The regression coefficients for all of these variables exceed twice their standard errors, and thus seem to reflect statistically significant associations in the directions implied by the model. The means, standard deviations, and simple correlations among the variables are summarized in Table 12.

The distance-to-city variable is significantly associated with this overall measure of migration (regression 2, Table 11), but rather than

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[1]The object is to specify a plausible behavioral relation between migration and the environmental variables that are not themselves determined simultaneously with, or subsequently by, the migration decision. It should be clear that a more realistic conception of migration would place it in the context of other household decisions (education, participation, fertility, marriage) and the regional allocation of other resources over time. It is hoped, however, that the simultaneous interactions that lead to estimation bias are relatively small here, and that this partial analysis of the underlying system of dynamic relations represents a step toward more satisfactory quantitative analysis of migration in developing countries. A summary of the definitions of the variables used in the regression analysis is given in the notes to Table 11.

Table 11

REGRESSIONS ON AVERAGE ANNUAL MIGRATION RATE FOR ALL PERSONS AGED 0 TO 44 IN 1951 IN COLOMBIA FROM 1951 TO 1964

Regression Number	Constant Term	Wage[a] 1956	Percent with Some Primary Schooling[b] Aged 5-9	Percent with Some Primary Schooling[b] Aged 10-14	Population Pressure[c] (surviving fertility in 1940-51)	Frequency of Violence[d] (1958-1963)	Distance to City[e] (log time)	Tenancy Proportion[f]	Capital/Man Ratio[g]	Land/Man Ratio[h]	R^2
1	5.06	.761 (2.94)	.110 (3.18)	-.101 (-5.04)	-.103 (-2.21)	-.034 (-4.77)	NI	NI	NI	NI	.314
2	8.13	.658 (2.62)	.090 (2.64)	-.113 (-5.87)	-.127 (-2.83)	-.034 (-4.82)	-1.260 (-3.54)	NI	NI	NI	.366
3	10.16	.655 (2.59)	.087 (2.50)	-.117 (-5.79)	-.127 (-2.78)	-.035 (-4.81)	-1.556 (-3.20)	.552 (.57)	NI	NI	.368
4	9.82	.653 (2.58)	.085 (2.46)	-.115 (-5.70)	-.123 (-2.52)	-.034 (-4.84)	-1.452 (-2.86)	NI	.092 (.28)	NI	.366
5	10.17	.656 (2.59)	.087 (2.45)	-.116 (-5.66)	-.129 (-2.80)	-.034 (-4.83)	-1.497 (-3.14)	NI	NI	.103 (.21)	.366
6	9.51	.656 (2.57)	.092 (2.54)	-.119 (-5.65)	-.119 (-2.41)	-.036 (-4.81)	-1.463 (-2.82)	.746 (.73)	.202 (.54)	.266 (.49)	.370

Notes:

In parentheses beneath regression coefficients are their t statistics or the ratio of the coefficients to their standard errors.

NI: variable not included in regression.

Definitions of regression variables:

[a] 1956 quarterly average of agricultural wages paid to men including food.

[b] 1964 census percentage of age group with some primary schooling.

[c] 1951 census estimate of surviving fertility from decade before census which approximates the potential rate of growth of the local supply of labor. See Section II for detailed derivation of this surviving fertility estimate.

[d] 1958-1964 reported frequency of violence per 10,000 persons in 1964 census.

[e] Logarithm (base 10) of the time required to travel from municipality's Cabecera to its Department capital or closer city, expressed in hours.

[f] Proportion of arable land reported in 1960 agricultural census to be farmed by tenants (non-landowners).

[g] Number of tractors reported in 1960 agricultural census per 10,000 persons enumerated in the agricultural census.

[h] Number of hectares of arable land reported in 1960 agricultural census per person in agriculture.

Table 12

MEANS, STANDARD DEVIATIONS, AND CORRELATION COEFFICIENTS OF VARIABLES USED IN OVERALL REGRESSION ANALYSIS

	Municipality Migration Rate Age 0-44 in 1951	Wage 1956	Primary Schooling Aged 5-9	Primary Schooling Aged 10-14	Population Pressure	Frequency Violence	Distance to City	Tenancy Proportion	Capital/Man Ratio	Land/Man Ratio
Mean	-2.25	2.37	22.2	69.8	40.9	8.76	.484	.211	.210	.525
Standard deviation	2.26	.70	8.2	13.8	3.7	24.9	.519	.178	.535	.340
Simple correlation coefficient										
Wage	.000	-								
Schooling 5-9	.011	-.033	-							
10-14	-.241	.068	.796	-						
Population	-.195	.110	-.260	-.180	-					
Violence	-.337	.408	-.103	-.022	.102	-				
Distance	-.191	-.098	-.500	-.438	.036	.027	-			
Tenancy	-.128	.097	-.099	-.007	-.021	.291	.185	-		
Capital	.121	.067	.138	.103	-.300	.073	-.299	-.186	-	
Land	-.096	.295	-.054	.101	.146	.034	-.062	-.128	-.325	-

the expected sign associated with an element of the cost of migration, the variable is positively associated with migration, suggesting that remoteness is in itself conducive to out-migration.

None of the determinants of the expected local wage or the derived demand for labor is significant in accounting for interregional variation in migration rates, though their signs are plausible. This result confirms my concern for the poor specification of the value of cooperating resources in agriculture that underlie the variables, and perhaps this finding is also linked to the general lack of specific theoretical framework for this component of the model.

Finally, no strong relationship emerged between the migration rates and any of the absolute or relative wage differentials based on both the local agricultural and the urban manufacturing wage series.[1] As discussed before, there are strong reasons for interpreting this result as further evidence that wage movements in the modern manufacturing sector do not reflect the income opportunities a potential migrant can hope to obtain access to if he resides in one of the six major city watersheds. The behavior of wages among these large manufacturing firms is far from typical for the urban sector.[2]

DISAGGREGATED MIGRATION

To proceed with the interpretation of these findings and translate the estimates into quantitative elasticity estimates, the municipal population is divided into several subpopulations. First the urban (Cabecera) and rural portions of the municipality are considered separately, distinguishing persons also by sex in Table 13. These estimates confirm that the migration model is basically intended and most

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[1] These results are not reported here for brevity. None of the constructed wage differentials or manufacturing wage series directly was statistically significant in the regression model, nor did their inclusion substantially change the other parameter estimates. This was also true at the disaggregate levels.

[2] R. L. Slighton, Relative Wages, Skill Shortages, and Changes in Income Distribution in Urban Colombia.

Table 13

REGRESSIONS ON AVERAGE ANNUAL MIGRATION RATES FOR PERSONS AGED 0 TO 44 IN 1951 IN COLOMBIA BETWEEN 1951 AND 1964, BY REGION AND SEX

Regression Number and Dependent Variable	Constant Term	Wage 1956	With Some Primary Schooling: Aged 5-9	With Some Primary Schooling: Aged 10-14	Population Pressure	Frequency of Violence	Distance to City	R^2
1. Both sexes								
Total municipality	8.13	.658	.090	-.113	-.127	-.034	-1.260	.366
		(2.62)	(2.62)	(5.87)	(-2.83)	(-4.82)	(-3.54)	
2. Men								
Total municipality	7.71	.781	.089	-.118	-.117	-.033	-1.300	.345
		(2.90)	(2.42)	(-5.74)	(-2.43)	(-4.39)	(-3.40)	
3. Women								
Total municipality	8.35	.544	.091	-.107	-.133	-.035	-1.234	.406
		(2.25)	(2.77)	(-5.78)	(-3.08)	(-5.13)	(-3.60)	
4. Both sexes								
Cabeceras (urban)	3.77	.235	.037	-.027	-.070	-.011	-1.327	.102
		(.66)	(.76)	(-1.01)	(-1.11)	(-1.11)	(-2.64)	
5. Men								
Cabeceras (urban)	3.38	.310	.055	-.044	-.057	-.006	-1.514	.095
		(.78)	(1.01)	(-1.43)	(-.79)	(-.58)	(-2.67)	
6. Women								
Cabeceras (urban)	3.71	.243	.030	-.021	-.073	-.014	-1.296	.113
		(.71)	(.64)	(-.80)	(-1.19)	(-1.50)	(-2.68)	
7. Both sexes								
Other regions (rural)	6.77	.560	.077	-.115	-.108	-.040	-.205	.331
		(1.88)	(1.91)	(-5.05)	(-2.04)	(-4.80)	(-.485)	
8. Men								
Other regions (rural)	6.41	.710	.077	-.119	-.100	-.038	-.351	.311
		(2.28)	(1.82)	(-5.02)	(-1.79)	(-4.45)	(-.80)	
9. Women								
Other regions (rural)	6.82	.419	.074	-.107	-.115	-.042	-.008	.342
		(1.43)	(1.84)	(-4.79)	(-2.18)	(-5.12)	(-.019)	

Notes:

See Notes to Table 11.

appropriate for understanding the inducements for rural-urban migration, and less appropriate to account for the patterns of inter-urban migration. Further disaggregation of migration into age and sex and region specific flows leads to the model estimates reported in Tables 14, 15, and 16. At this finer level of analysis a number of further patterns emerge about the responsiveness of particular groups to the forces that seem to propel the migration process.

INTERPRETATION OF MIGRATION RESPONSE ESTIMATES

The association between daily wages in agriculture and migration is strongest for the young, among whom migration is most common. No effect of rural wages on migration rates is evident after age 26 (for men in 1958). Since wages for women are reported for only a few municipalities, the wage variable pertains only to men's wages, hence the women's migration rate is understandably less sensitive than the men's to this measure of wages. Without any urban wage data at the regional level, these results imply only that migration from the Cabeceras is not particularly sensitive to the level of agricultural wage in neighboring rural areas. Doubling rural wages (relative to urban levels), nevertheless, according to the overall regression estimates in Table 11, is associated with 70 percent less migration out of all sampled areas.

Primary schooling for those aged 10 to 14 is associated with out-migration for both sexes and for all age groups, though the magnitude of the regression coefficients declines with age as do the absolute levels of out-migration rates. The younger primary school attendance variable acts as a non-wage benefit restraint on out-migration, though it is less potent than direct wage benefits. Confirming the hypothesis that this variable might affect migration through its influence on parents with school-aged children, this variable is most powerful for the 7 to 11 aged cohort and cohorts over the age of 27. Alternative specifications of the education variables in terms of literacy or completion of primary school yielded similar results with the noted reversal in sign between the youngest and older aged groups in the population.

Table 14

REGRESSIONS ON AGE AND SEX SPECIFIC AVERAGE ANNUAL MIGRATION RATES FOR REPRESENTATIVE SAMPLE MUNICIPALITIES IN COLOMBIA 1951 TO 1964
(Sample Size 131)

Sex and Age in 1958	Wage 1956		Primary Schooling Aged 5 - 9		Primary Schooling Aged 10 - 14		Population Pressure		Frequency of Violence		Distance to City		R^2
	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	
Men 7-11	.665	2.50	.125	3.43	-.127	-6.23	-.130	-2.72	-.033	-4.48	-1.124	-2.98	.384
12-16	1.207	3.79	.090	2.07	-.147	-6.04	-.201	-3.53	-.021	-2.42	-1.721	-3.81	.376
17-21	1.224	3.50	.062	1.31	-.144	-5.40	-.257	-4.12	-.016	-1.67	-1.766	-3.57	.354
22-26	.968	3.13	.075	1.78	-.123	-5.21	-.187	-3.37	-.030	-3.47	-1.294	-2.95	.333
27-31	.358	1.14	.092	2.15	-.080	-3.36	-.015	-.27	-.042	-4.82	-.714	-1.62	.248
32-36	.356	1.34	.074	2.05	-.061	-3.02	-.008	-.18	-.046	-6.22	-.702	-1.86	.317
37-41	.185	.71	.083	2.33	-.071	-3.55	.016	.34	-.041	-5.71	-.512	-1.38	.303
42-46	.224	.88	.079	2.26	-.061	-3.14	.002	.04	-.041	-5.72	-.728	-2.00	.304
47-51	-.110	-.41	.085	2.31	-.059	-2.88	.021	.43	-.032	-4.26	-.644	-1.69	.242
Women 7-11	.699	2.77	.110	3.19	-.118	-6.12	-.145	-3.22	-.037	-5.25	-1.311	-3.67	.426
12-16	1.103	3.86	.087	2.23	-.136	-6.26	-.240	-4.70	-.037	-4.62	-1.818	-4.49	.459
17-21	.704	2.43	.091	2.31	-.140	-6.33	-.219	-4.23	-.029	-3.62	-1.552	-3.78	.409
22-26	.278	1.03	.080	2.16	-.095	-4.60	-.107	-2.22	-.031	-4.09	-1.132	-2.95	.305
27-31	.157	.65	.081	2.45	-.062	-3.34	-.057	-1.32	-.031	-4.59	-.589	-1.71	.265
32-36	.297	1.22	.074	2.21	-.068	-3.63	-.044	-1.01	-.035	-5.12	-.655	-1.89	.282
37-41	.065	.28	.097	3.10	-.081	-4.61	-.031	-.75	-.034	-5.29	-.807	-2.48	.350
42-46	.353	1.52	.074	2.34	-.072	-4.08	-.044	-1.06	-.037	-5.78	-.960	-2.92	.344
47-51	.167	.67	.099	2.93	-.069	-3.68	-.013	-.30	-.032	-4.60	-1.016	-2.90	.302

Notes:
See Notes to Table 11.

Table 15

REGRESSIONS ON AGE AND SEX SPECIFIC AVERAGE ANNUAL MIGRATION RATES FOR RURAL PORTIONS OF COLOMBIA 1951 TO 1964[a]
(Sample Size 131)

Sex and Age in 1958	Wage 1956		Primary Schooling Aged 5 - 9		Primary Schooling Aged 10 - 14		Population Pressure		Frequency of Violence		Distance to City		R^2
	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	
Men 7-11	.581	1.45	.124	2.27	-.144	-4.70	-.107	-1.49	-.039	-3.47	-.473	-.83	.246
12-16	1.245	3.57	.041	.87	-.132	-4.98	-.200	-3.21	-.025	-2.59	-.568	-1.15	.325
17-21	1.333	3.51	.030	.57	-.138	-4.77	-.273	-4.02	-.021	-1.97	-.779	-1.45	.331
22-26	.905	2.59	.078	1.64	-.135	-5.05	-.182	-2.90	-.035	-3.60	-.445	-.90	.308
27-31	.169	.45	.114	2.25	-.097	-3.42	.032	.48	-.048	-4.67	-.115	-.22	.240
32-36	.114	.36	.089	2.03	-.072	-2.93	.022	.39	-.051	-5.72	.099	.22	.286
37-41	.065	.21	.105	2.51	-.080	-3.42	.039	.72	-.047	-5.51	.365	.84	.297
42-46	.119	.39	.085	2.02	-.058	-2.48	.010	.18	-.044	-5.08	.192	.44	.238
47-51	-.225	-.66	.071	1.53	-.048	-1.86	.043	.71	-.036	-3.81	.170	.35	.175
Women 7-11	.495	1.73	.077	1.98	-.116	-5.33	-.094	-1.84	-.042	-5.32	.131	.32	.375
12-16	1.019	3.14	.042	.94	-.130	-5.25	-.215	-3.71	-.042	-4.67	-.286	-.62	.394
17-21	.677	2.04	.068	1.51	-.134	-5.28	-.209	-3.51	-.035	-3.77	-.432	-.92	.344
22-26	.227	.75	.108	2.60	-.114	-4.89	-.067	-1.22	-.039	-4.64	-.173	-.40	.307
27-31	-.018	-.06	.119	2.73	-.084	-3.44	-.029	-.51	-.038	-4.33	.217	.48	.246
32-36	.080	.25	.075	1.72	-.072	-2.97	-.041	-.72	-.041	-4.61	.300	.66	.239
37-41	-.014	-.04	.084	1.95	-.075	-3.13	-.028	-.49	-.046	-5.22	.424	.95	.286
42-46	.204	.64	.054	1.25	-.061	-2.52	-.042	-.74	-.044	-4.98	.167	.37	.235
47-51	.062	.19	.097	2.16	-.067	-2.66	.018	.31	-.042	-4.58	.215	.46	.219

Notes:

[a]Rural portions defined as those areas of municipalities other than the Cabeceras or municipal administrative center.

See Notes to Table 11.

Table 16

REGRESSIONS ON AGE AND SEX SPECIFIC AVERAGE ANNUAL MIGRATION RATES FOR THE CABECERAS OR URBAN PORTIONS OF COLOMBIA 1951 TO 1964
(Sample Size 131)

Sex and Age in 1958	Wage 1956		Primary Schooling Aged 5 - 9		Primary Schooling Aged 10 - 14		Population Pressure		Frequency of Violence		Distance to City		
	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	Coef.	"t"	R^2
Men 7-11	.376	.92	.045	.81	-.026	-.83	-.113	-1.55	-.017	-1.46	-1.080	-1.86	.092
12-16	.622	1.37	.074	1.19	-.066	-1.89	-.091	-1.20	-.008	-.64	-2.237	-3.48	.150
17-21	.045	.08	.053	.72	-.061	-1.48	-.102	-1.06	.003	.26	-2.149	-2.81	.087
22-26	-7.358	-1.69	-.166	-.27	.288	.87	-.540	-.70	.056	.46	-1.802	-.29	.039
27-31	.033	.07	.052	.76	.001	.05	-.085	-.95	-.000	-.03	-.105	-.15	.031
32-36	.430	.97	-.012	-.21	.028	.83	-.063	-.80	-.017	-1.38	-.450	-.72	.049
37-41	-.050	-.11	.008	.13	.006	.17	.016	.19	-.015	-1.24	-.273	-.43	.022
42-46	.016	.03	.003	.05	.001	.03	.049	.61	-.019	-1.51	-.577	-.91	.034
47-51	.129	.30	.155	2.62	-.060	-1.81	-.020	-.26	-.012	-1.00	.138	.22	.076
Women 7-11	.394	.95	.018	.31	.020	.63	-.111	-1.50	-.020	-1.75	-1.172	-1.99	.138
12-16	.457	1.02	.040	.65	-.024	-.71	-.140	-1.75	-.020	-1.64	-1.783	-2.82	.141
17-21	.121	.29	.055	.98	-.072	-2.31	-.162	-2.21	-.016	-1.39	-1.904	-3.28	.162
22-26	-.323	-.74	.001	.01	-.013	-.37	-.071	-.90	-.007	-.57	-1.413	-2.28	.064
27-31	.379	1.10	.023	.49	.006	.23	.006	.10	-.008	-.87	-.672	-1.37	.061
32-36	.317	.82	.008	.15	-.016	-.55	-.017	-.24	-.016	-1.54	-.441	-.81	.028
37-41	-.220	-.68	.016	.37	-.014	-.55	-.036	-.63	-.003	-.34	-.892	-1.95	.051
42-46	.435	1.22	.047	.98	-.028	-1.04	-.020	-.31	-.019	-1.92	-.674	-1.33	.068
47-51	-.397	-1.13	.004	.08	.007	.27	.009	.14	-.006	-.61	-1.120	-2.25	.080

Notes:
See Notes to Table 11.

The responsiveness of migration rates to the educational characteristics of the population is substantial. Increasing the proportion of young children attending primary school (age 5-9) from 22 percent to 44 percent is associated, according to these regression estimates, with a short-run decline of 45 percent in the overall out-migration rate (regression 1, Table 11). But, if school attendance were also subsequently raised among the children aged 10 to 14 from 70 to 92 percent, the associated out-migration rate would appear to double. On balance, these estimates imply that if both age groups in the population benefited from this increased exposure to the school system, out-migration would increase by half in the next decade.[1]

The distance-to-city variable helps to account for differences in migration rates among the Cabeceras only. Young men and women living in remote towns are more likely than those living close to the big city to migrate from their community.[2] This relationship is statistically significant for men until the age of 21, persists for women until 26, and reappears again for women between the ages of 47 and 51. Distance to the city does not appear to affect the propensity of the rural population to migrate. Since other studies of migration have also found remoteness to urban labor markets associated with heavier out-migration, distance should be deemphasized as a prime consideration in the estimation of the cost of migration.[3]

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[1] Caldwell observes also in Ghana that education increases the individual's propensity to migrate, on balance, from rural to urban residence. J. C. Caldwell, "Determinants of Rural-Urban Migration in Ghana," Population Studies, Vol. 22, No. 3, November 1968.

[2] To translate the implications of the coefficients estimated in regression 1 of Table 11 into quantitative terms, the average municipality in the sample was about three hours travel time from the capital of its state (Departamento). If the municipality were six hours from the capital, the associated out-migration rate would be some 16 percent greater than for the municipality which was on the average three hours from its capital. If the municipality were only one hour away from the capital, the out-migration rate would be 26 percent less than for the average, other things being equal.

[3] See William D. Diehl, "Farm-Nonfarm Migration in the Southeast: A Costs-Benefits Analysis," Journal of Farm Economics, Vol. 48, No. 1, February 1966.

Violence is rurally contained, so far as it is associated with rural out-migration in Colombia. In only one age-sex group (men between the ages of 17 and 21 -- the violence makers) is out-migration from rural areas not significantly associated with the frequency of violence (Table 15). Among Cabecera populations there appears to be no relation between the region's violence rate and its migration rate for any age or sex component of the population. Nonetheless, one death by violence is associated with a net out-migration of approximately 40 persons from the immediate rural area. Middle-aged men are slightly more sensitive to this inducement to migrate than are younger men, and women in both the very young and older age cohorts depart the violence-torn regions at the highest rates.[1] According to these estimates, if the average municipal incidence of violent deaths had been nil rather than the figure recorded of 8.7 per 10,000, the associated overall migration rate out of the sampled regions would have been 13 percent lower, or reduced from 2.25 to 1.95 percent per year.[2]

A high level of surviving fertility in the decade before the 1951 census is interpreted here as a measure for the differential effect of the population explosion on the rate of growth of the potential labor force during the 1950s. The relation between this measure of the "population pressure" and out-migration is most noticeable for the young (up to about the age of 26). Because each generation is a poor substitute for another, the youngest generation experiences the strongest competitive employment pressure from the growth of their own age group, depressing local returns to their labors, and forcing them in particular to migrate from the country to the city or frontier

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[1] It should be noted that this estimate of the migration effect of violence is likely to be an overestimate, for the definition of migration includes any decline in regional population in excess of normal mortality. Some of the violent deaths are undoubtedly being attributed to out-migration, thus inflating the true effect of violence on the migration of the surviving population.

[2] Elasticity response computed at variable means from regression 1, Table 11. For only the rural subsector the reduction in average migration implied by regression 7, Table 11, would have been 10 percent from 3.06 to 2.71 per year, in the absence of any violence.

territory.[1] According to the estimated relationship taken at regression means, a 20 percent reduction in surviving fertility is associated with a 40 percent reduction in the out-migration rates of men and a 50 percent reduction in the out-migration rates of women.[2] A modest reduction in birth rates is thus associated with a substantial decline in internal migration.

Because of the continuing fall in death rates and the relative stability of birth rates in Colombia during the 1950s, the measure of surviving fertility or "population pressure" analyzed here did not fall in the period 1951 to 1964. On the contrary, it increased by about 20 percent. If the estimated migration association holds during the next decade, migration rates will increase by about half over that of the period studied here. In the past the rural labor force grew by only .4 percent compared with the urban 4.4. There are reasons to believe that in the next decade population growth and internal migration will proceed still more rapidly; there will continue to be only a negligible increase in the rural labor force, and the urban labor force will grow 5 to 6 percent per year. Population growth remains the potent engine behind this pattern of accelerating migration and has also undoubtedly contributed to the problem of urban unemployment. The short-run future is already cast in the past, but a resolution to the population problem is a prerequisite if development is to become more than a holding operation in Colombia.

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[1] By an analysis of individual survey data, Caldwell has substantiated that in Ghana a person is more likely to migrate from his rural residence to the city if he is born into a large family. Indeed, the total number of siblings of the same sex is an even stronger predictor of the propensity to migrate. This micro individual evidence is, of course, consistent with my hypothesis that communities that experience more rapid population growth and increases in family size are also likely to experience higher out-migration rates among their youth. J. C. Caldwell, "Determinants of Rural-Urban Migration in Ghana," p. 371.

[2] Regressions 2 and 3 of Table 13.

SUMMARY AND CONCLUSIONS

One-third of the rural Colombian population who were under the age of 40 in 1951 and lived outside of the Cabeceras had left these areas by 1964. This large outflow of migrants approximately equaled the excess of births over deaths in these rural areas, and consequently the rural population grew very slowly between these census years. Only among the youngest and oldest age groups did the rural population increase. Small towns on balance lost people to migration, but this small net outflow may conceal larger gross migration rates in which those leaving the countryside moved to town and simultaneously better educated town dwellers moved to the city. The importance of this form of "stepwise" migration is difficult to discover from the data studied here, though it is evident nevertheless that large numbers leaving the land moved directly to cities. The growth of towns larger than 10,000 was spurred by in-migration of almost 2 percent per year. About two-fifths of the population growth of these larger towns and cities appears to have been due to in-migration between 1951 and 1964. Because the migrant tended to be young and economically active, the in-migration contributed relatively more to the growth of the urban labor force than their numbers would imply, and held the rural labor force virtually constant. In Bogota, for example, 45 percent of the 1964 residents in the economically active ages had migrated to the city in the prior eleven years.

This wave of rural-urban migration appears to have been heightened by the increase in the rate of population growth which followed as a consequence of the spread of improved sanitation and health practices after the 1940s. The further reduction in infant and child mortality since 1950 should add to these pressures of population growth in the 1960s and further increase the already high rate of migration from the rural labor market into the cities. Reducing the incidence of rural violence will contribute to reducing rural-urban migration rates, but this factor is not quantitatively as important as the underlying "population explosion." There is also evidence that schooling, though a local attraction to parents, facilitates out-migration of students,

equipping them to better evaluate and respond to employment opportunities in the city where returns to education appear to be higher than in the countryside.

Aside from the general scarcity of reliable information for Colombia, and the consequent rough nature of this exploratory econometric investigation into the determinants of fertility and migration, the most serious shortcoming of this study is lack of a satisfactory model for the derived demand for labor. Real wages for agricultural labor in Colombia have not increased much in the last couple of decades. This could presumably change, if government policy sought effectively to raise labor productivity in both traditional and modern commercial agricultural activities. Increased labor productivity would increase the relative level of agricultural wages. Allowing for the subsequent possible decline in agricultural prices, the long-run effects of such policies on the aggregate demand for labor in agriculture are less certain, but vigorous growth of the agricultural sector could, nevertheless, sharply curtail the current pace of rural-urban migration. This investigation has regrettably not been able to cast any light on the design of particular policies associated with such beneficial labor promotion developments in Colombian agriculture.

Migration in Colombia appears to follow predictable lines, reducing disequilibrium between regional labor markets. The evidence confirms that interregional migration responds strongly to market forces drawing rural labor to the cities from regions where the returns to labor are relatively low and the supply of labor is growing relatively rapidly. Though incomes of much of the urban labor force have stagnated during the last decade, they are nevertheless still substantially in excess of those earned by comparably educated persons in the countryside.[1] Internal migration of the magnitude recently experienced by Colombia is therefore the consequence of

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[1] See Appendix B, and for evidence on the stagnation of urban wages in the traditional sectors, see Slighton, Relative Wages, Skill Shortages, and Changes in Income Distribution in Urban Colombia.

fundamental forces that will not be turned aside lightly. In terms of the economic objectives of raising labor productivity and increasing national income, migration almost certainly has a beneficial effect that outweighs the social costs incurred in providing housing and public services at a higher cost in the urban than in the rural areas. The concentration of poor and unemployed in the cities may, on the other hand, pose a political problem that is easier to manage when people are poorer, but dispersed throughout the countryside. But even this political argument against internal migration is empirically unsubstantiated.[1]

If the urban unemployment problem becomes worse, rural-urban migration will probably be self limiting. But pressures for corrective policies may mount. An implication of our findings is that migration is highly responsive to economic and political conditions in the city and countryside, and in this sense does not require regulatory attention.

Internal migration performs an important function in the development process, facilitating structural change in the economy that raises national productivity and income, and keeps the difference between rural and urban incomes in bounds. Policy should not be aimed at curbing internal migration to relieve urban unemployment, either through rural public works or regulatory measures. Rather, positive measures are needed to promote the demand for labor in rural and urban occupations. One policy strategy would seek to erode the protected income status of the modern urban industrial sector by opening the

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[1]The evidence I have seen from sociological surveys of migrant barrios of Latin American cities suggests that the urban in-migrant tends to be politically conservative and accept middle class values, and he tends to work harder and experience less unemployment than his counterpart born in the city. The first generation urban in-migrant improves his lot and shows few radical tendencies, but the story may be different for the second generation who does not have the perspective of rural poverty on which to judge his current state of affairs. See, for example, the survey by Richard M. Morse, "Recent Research on Latin American Urbanization," Latin American Research Review, Vol. 1, No. 1, Fall 1965.

economy to stronger competitive pressures, in both the product and factor markets.[1]

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[1]These policy issues are treated in greater detail in another study, R. R. Nelson, R. L. Slighton, and T. P. Schultz, Colombian Development Policy, R-461-AID/RC, February 1969.

Appendix A

POPULATION AND LABOR FORCE GROWTH

This appendix estimates birth and death rates for Colombia from various demographic sources. Estimation of the life table appropriate to Colombia then permits the projection of the size and composition of the population and labor force to 1974. The principal shortcoming of this approach is that it uses essentially mechanical schemes for projecting past patterns of fertility and mortality into the future, without attempting to specify the factors that endogenously determine the future course of fertility and mortality in the population. Another weakness is the reliance on indirect evidence from censuses to estimate past patterns of fertility and mortality since registrations of births and deaths are incomplete. Though the quasi-stable population model approach employed here to estimate population trends appears to be the best available, the appropriateness of this method and "West" life tables used here for the Colombian situation cannot be assayed with confidence.[1]

DEMOGRAPHIC MATERIALS AND INDIRECT ESTIMATES OF VITAL RATES

When the registrations of births and deaths are incomplete, other evidence must be used to estimate birth rates and the regime of mortality. One approach to this problem is to compare the number of persons surviving from one census to another, deriving from this information the regime of mortality and implied birth rate. This method requires age distributions of the population that are not systematically distorted by misreporting or under-enumeration. Inconsistencies of this sort in Colombian data for the youngest and the older age cohorts conform to common patterns found in other Latin American countries, but

[1] Using the "South" class of life tables leads to higher birth and death rates. It was judged that these higher rates (about 5 per thousand) were unreasonable given the level of birth and death rates estimated in prior periods by Lopez and the level of death rates estimated for other Latin American countries.

these weaknesses in age distribution data preclude the strict application of the reverse-survival procedure for estimating vital rates.

The other methods yield estimates that are quite insensitive to the distortions in age distribution; one is based on the regularities of the cumulative age distribution of populations conforming to quasi-stable population characteristics and the other relies on multivariate relationships between various indirect demographic measures of fertility estimates for a worldwide sample of countries.

In a closed population where birth rates are relatively stable and death rates have fallen in a prescribable fashion, the current rate of population growth in conjunction with the age distribution of the population imply a unique combination of birth and death rates. This procedure also presumes that the level of mortality implies a pattern of age-specific mortality which conforms to life tables that are well documented from Europe, areas of European settlement, and Japan. A class of "West" life tables (estimated by Coale and Demeny) is used here to approximate the pattern of mortality presumed to exist in Colombia today.

Because of controversy on the coverage of the 1951 Colombian census, the quasi-stable population procedure is applied using two sets of assumptions. Assumption A uses the official adjusted estimates for the 1951 census made by DANE (see Tables A-1 and A-2). The DANE estimates imply an average annual rate of growth of the male population of 3.2 percent and the female population of 3.3 percent between the census years of 1951 and 1964. These 1951 estimates also suggest that about twenty years ago, midway between the 1938 and 1951 censuses, the male and female populations were increasing at about 2.1 percent per year. If fertility had not changed historically, these rates of growth in conjunction with the 1964 age distribution of the male and female population under the age of 40 could be used to estimate the appropriate life tables for both the male and female populations.[1] The median vital

[1]Age misreporting becomes too serious a problem to use data on the population over the age of 40.

Table A-1

COLOMBIAN AGE AND SEX DISTRIBUTION OF POPULATION AS REPORTED IN THE CENSUSES OF 1938, 1951, AND 1964
(thousands)

	1938		1951		1964	
Age in Years	Male	Female	Male	Female	Male	Female
0-1	146	145	210	201	319	312
1-4	525	521	742	721	1243	1212
0-4	671	666	952	922	1562	1524
5-9	630	617	794	769	1419	1382
10-14	547	522	684	658	1148	1121
15-19	421	472	545	605	836	930
20-24	406	415	532	551	671	746
25-29	334	358	409	447	550	616
30-34	265	266	342	337	500	530
35-39	266	264	318	334	443	481
40-44	199	205	248	240	360	359
45-49	154	150	194	197	291	301
50-54	137	142	183	176	262	256
55-59	79	110	110	106	167	164
60-64	88	107	107	117	164	176
65-69	40	41	62	63	92	97
70-74	34	43	46	57	68	81
75-79	16	17	24	27	39	44
80-84	14	20	17	25	24	33
85+	10	15	11	19	17	28
Distributed total	4310	4387	5579	5649	8615	8870
Total both sexes	8,697		11,228		17,485	
Official adjustment for omissions	24		192		n.a.	
Indigenous populations	-		128		n.a.	
Estimate of child underreporting	150		41		82[a]	
Official DANE estimate	8,850		11,589		-	
Lemieux adjustment	-		612		-	
Lemieux estimate	-		12,200		-	

Table A-1 (Continued)

Notes:

- indicates not applicable.

n.a. indicates not available.

[a]The author's minimum estimate. The age distribution analysis suggests more appropriate estimates would be twice this large or about 193.

Source:

Published Census materials for 1938 and 1951, and unpublished 1964 resumes. Adjustments of Lemieux from Some Aspects of Population Growth in Colombia, United Nations, Economic Commission for Latin America, E/CN.12/618, November 10, 1962, pp. 5-7.

Table A-2

RATES OF POPULATION GROWTH BETWEEN CENSUSES AND THEIR DERIVATION, BY SEX AND RESIDENCE: 1936-1964

Census Totals	Total by Sex	Males	Females	Cabeceras "Urban"	Other Regions "Rural"
1938	8,687	4,310	4,387	(2,537)	(6,150)
1951	11,228	5,579	5,649	4,467	7,075
1964	17,485	8,615	8,870	9,094	8,391
Adjusted totals					
1938	8,850	4,395	4,465	(2,610)	(6,240)
1951 - Lemieux	12,200	6,063	6,137	4,600	7,600
1951 - DANE	11,589	5,759	5,829	4,482	7,106
1964	17,567	8,657	8,910	9,094	8,391
Annual average rate of growth					
1938-1951 - L	2.71	2.72	2.69	(4.3)	(1.5)
1951-1964 - L	2.84	2.77	2.90	5.38	.76
1938-1951 - D	2.07	2.10	2.06	(4.2)	(.9)
1951-1964 - D	3.25	3.19	3.32	5.59	1.24

Source:

Table A-1 and other Census materials. "Rural-Urban" population in 1938 is shown in parentheses because these data are only approximately estimated from growth rates given in Some Aspects of Population Growth in Colombia, ECLA, United Nations, E/CN.12/618, November 10, 1962, Table 1, p. 29.

rates of the interpolated and adjusted estimates are shown in the first part of Table A-3.[1]

Assumption B accepts the adjustments to the 1951 census proposed by the Canadian demographer, Lemieux, who thoroughly studied the results of the Colombian census during the early 1950s. Lemieux estimated that the DANE total was 700,000 too small for 1951. Using his estimate the male population grew at an average annual rate of 2.8 percent and the female population at 2.9 percent between 1951 and 1964. Lemieux's estimates for 1951 also imply that the rate of growth of the male and female population between the censuses of 1938 and 1951 was 2.7 percent per year. Assumption B is based on these estimated rates of growth of the population which imply virtually no acceleration in the overall rate of population growth since the early 1940s. With the Colombian population growing at about 2 percent per year in the 1930s, it is further assumed that fertility has been roughly constant since the 1930s and that the gradual decline in death rates explains the increase from 1930 to 1960 in the annual rate of population growth from 2.0 to 2.8 percent for males and 2.0 to 2.9 percent for females. These assumptions underlie the second set of estimated vital rates shown under B in Table A-3.

Assumption B implies unrealistically high crude death rates of 20 per thousand, whereas the recorded death rate is 11 and informed estimates place it at around 15 per thousand. Furthermore, it is unrealistic to assume (as is implicit in B) that the rate of population growth has been relatively constant since the 1940s, when other evidence of a postwar acceleration in population growth is convincing. Assumption A, on the other hand, implies a death rate for both sexes of 14 per thousand, slightly higher than official estimates though not unreasonable. The estimated level of birth rates under Assumption A is similar to estimates by Lopez and others for earlier periods.[2] The

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[1]The various steps in the estimation procedure are spelled out in the U.N. Manual IV, Methods of Estimating Basic Demographic Measures from Incomplete Data, New York, 1967.

[2]Alvaro Lopez, Problems in Stable Population Theory, Princeton University Press, Princeton, 1961, Chapter 5.

Table A-3

INDIRECT ESTIMATES OF BIRTH AND DEATH RATES FOR COLOMBIA, 1964
(per thousand)

Quasi Stable Population Procedure	Assumed Rate of Population Growth	Estimated Crude Birth Rate	Implied Crude Death Rate
Assumption A[a]			
Males	32.0	47.38	15.38
Females	33.0	45.82	13.82
Both sexes	32.5	46.59	14.09
Assumption B[b]			
Males	28.0	50.03	22.03
Females	29.0	47.24	16.24
Both sexes	28.5	48.62	20.12
Multiple regression technique[c]			
Both sexes with main variable:			
Child (0-4) - woman ratio	(32.0)	46.03	(14.03)
Child (5-9) - woman ratio	(32.0)	46.85	(14.85)
Child (0-4) - population ratio	(32.0)	45.66	(13.66)
Child (5-9) - population ratio	(32.0)	45.41	(13.41)
Child (0-14) - population ratio	(32.0)	46.87	(14.87)

Notes:

Parentheses indicate that numbers are not estimates but assumed or implied by assumptions.

[a]Rate of population growth as indicated in officially adjusted census totals increased from about 2.0 percent per year in the period before 1950 to 3.2 percent per year from 1951 to 1964.

[b]Rate of population growth as indicated by adjusted census figures prepared by Lemieux which imply about 2.0 percent growth before 1938, 2.7 percent from 1938 to 1951, and 2.9 percent per year from 1951 to 1964.

[c]Rate of population growth assumed to be 3.2 percent per year as in (a) above, and other variables were estimated as cited in text.

pattern of accelerating population growth implied by Assumption A, though perhaps somewhat exaggerated, is nevertheless closer to the truth than the constant rate of growth implied by Lemieux's estimates.

The second approach to estimating Colombia's birth and death rates utilizes various facets of the 1964 age distribution plus other demographic information. By regression analysis for a sample of 50 countries Bogue and Palmore estimated the multivariate relationships between crude birth rates and infant mortality (115 in Colombia), average age of marriage (22), the percent of women ever married at age 45-49 (85), an index of age composition (1.0), and five child/woman and child/population indirect measures of fertility.[1] Using their regression coefficients and the limited information available on the Colombian environment, five estimates of birth rates were calculated, which cluster closely about 46 per thousand. Death rates are not independently estimated by this scheme, but if the official 1951 census estimates are accepted and the overall rate of population growth was about 3.2 percent per year, then the implied level of death rates are as shown in parentheses in Table A-3.

POPULATION AND LABOR FORCE PROJECTIONS

The preferred estimate of the vital rates for Colombia in 1964 are those derived under Assumption A. The level of mortality for both male and female populations is the same according to the "West" Life Tables (Level 14) under Assumption A. The survival rates implied by this level of mortality are computed for ten year intervals and given in Table A-4. Applying these survival rates to the adjusted 1964 age/sex specific population totals yields minimum estimates for the surviving population in 1974. Since death rates are likely to decrease as living and health conditions in the country improve, the surviving population may slightly exceed these estimates. To complete the age

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[1] D. J. Bogue and J. A. Palmore, "Some Empirical and Analytic Relations among Demographic Fertility Measures with Regression Models for Fertility Estimation," Demography, Vol. 1, No. 1, 1964, p. 328.

Table A-4

SURVIVAL RATES FOR MORTALITY LEVEL 14
OF "WEST" LIFE TABLE[a]

Survival Ages in Years	Males	Females
0-4 to 10-14	.9379	.9382
5-9 to 15-19	.9682	.9668
10-14 to 20-24	.9602	.9602
15-19 to 25-29	.9478	.9497
20-24 to 30-34	.9392	.9415
25-29 to 35-39	.9305	.9341
30-34 to 40-44	.9169	.9260
35-39 to 45-49	.8974	.9160
40-44 to 50-54	.8695	.8987
45-49 to 55-59	.8290	.8688
50-54 to 60-64	.7711	.8210
55-59 to 65-69	.6903	.7489
60-64 to 70-74	.5843	.6473
65-69 to 75-79	.4526	.5129
70+ to 80+	.2399	.2763
Implied Characteristics of Life Table		
Infant mortality	124.53	105.48
Life expectancy at birth (in years)	49.6	52.5

Note:

[a]The proportion of persons in a given five-year age group in the stationary population alive ten years later. The mortality level 14 for the "Western" Model appears to correspond most nearly with the current regime of mortality in Colombia according to the estimates made in this Memorandum.

Source:

For discussion of methods used see Methods of Estimating Basic Demographic Measures from Incomplete Data, UN Manual IV on methods of estimating population, New York, 1967; and for the life tables, Ansley Coale and Paul Demeny, Regional Model Life Tables and Stable Populations, Princeton University Press, Princeton, 1966, p. 15.

distribution of the population and include the youngest cohorts who are born between 1964 and 1974, it is assumed that the average annual rate of population growth continues to be 3.2 percent, perhaps somewhat faster in the late sixties and somewhat slower in the seventies. This assumption might overestimate future birth rates if family planning services were widely provided to the population by the end of the 1960s. Labor force estimates for 1974 are for obvious reasons insensitive to the level of births in the next decade.

To translate this estimate of the population in 1974 into the number of persons economically active in the labor force, participation rates for various age and sex specific groups are postulated. Two alternative assumptions are irvestigated here. First, it is assumed that participation rates in 1964 are applicable in 1974 (Estimate C). Second, it is assumed that participation rates change in the same proportion between 1964 and 1974 as they did between 1951 and 1964 (Estimate D) (see Table A-5). This implies that male participation rates will continue to fall in urban areas that are growing rapidly while female rates will continue to rise moderately because of urban in-migration and expanding educational opportunities. I suspect that both alternative participation rates understate probable levels of participation. Male participation rates are not likely to fall much further with development unless unemployment becomes very severe or education expands much more rapidly than in the past, and female participation rates are likely to rise more rapidly than they did between the last two censuses. Consequently, these estimates of the labor force in 1974 are biased downward both by survival and participation assumptions (Table A-6).

Using either C or D to estimate the size of the labor force in 1974 it is evident that the labor force will grow more rapidly in the next decade than it did in the last. Table A-7 shows that using the DANE official estimates, which may somewhat overstate population growth from 1951 to 1964, the average annual rate of growth in the labor force was 2.2 percent. My two estimates for the labor force in 1974 imply an average annual rate of growth in the labor force between 1964 and

Table A-5

ECONOMICALLY ACTIVE POPULATION PER HUNDRED: COLOMBIA, 1951 AND 1964

Age in Years	Total Population				Cabeceras or "Urban" Population				Other Regions or "Rural" Population			
	Male		Female		Male		Female		Male		Female	
	1951	1964	1951	1964	1951	1964	1951	1964	1951	1964	1951	1964
10-14	16.9	15.7	6.2	4.3	n.a.	6.4	n.a.	5.6	n.a.	24.6	n.a.	2.7
15-19	84.8	66.3	23.6	21.8	71.8	47.6	34.8	28.9	92.3	85.4	14.1	11.1
20-24	95.4	89.9	23.9	26.3	91.4	83.5	35.6	36.2	98.0	96.6	14.0	12.3
25-34	97.6	96.4	19.7	20.8	96.3	94.7	27.6	27.9	98.4	98.2	13.2	11.4
35-44	97.9	97.4	19.1	19.8	96.9	96.5	25.2	25.7	98.4	98.3	14.3	12.5
45-54	96.8	96.0	18.0	18.9	95.3	94.3	21.1	22.5	97.8	97.6	15.3	14.2
55-64	92.7	89.4	15.7	15.3	88.7	84.6	16.4	16.3	94.9	94.3	15.1	13.8
65+	71.8	58.8	10.3	8.5	62.8	48.7	9.3	8.4	77.0	69.0	11.2	8.4
Total population	54.7	47.6	6.2	11.6	53.2	43.6	18.3	16.0	55.6	51.5	8.1	6.5

Note:

n.a. indicates not available from secondary sources used.

Sources:

1951 census figures for total population from Demographic Aspects of Manpower, Report 1, Sex and Age Patterns of Participation in Economic Activities, Department of Economic and Social Affairs, United Nations, Population Study No. 23, Table A-2 and A-3, pp. 58-62; 1951 census regional figures from Some Aspects of Population Growth in Colombia, ECLA, United Nations, E/CN.12/618, November 10, 1962, Table 56, p. 81; 1964 census figures from unpublished materials.

Table A-6

POPULATION AND LABOR FORCE PROJECTION FOR COLOMBIA IN 1974

Age in Years in 1974	Survived 1964 Census Totals Unadjusted		Adjusted Totals for Census Underreporting of Children and Continued Pattern of Birth and Death Rate		1974 Participation Rates Assumption C 1964 Rates Apply to 1974		1974 Participation Rates Assumption D Relative Change 1951-1964 Continues[a]		Labor Force Estimate Assumption C		Labor Force Estimate Assumption D	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	(thousands)				(percent)				(thousands)			
0-4	-	-	2,293	2,254	.0	.0	.0	.0	-	-		
5-9	-	-	1,764	1,727	.0	.0	.0	.0	-	-		
10-14	1,450	1,431	1,489	1,469[b]	15.7	4.3	14.6	3.0	234	63	232	44
15-19	1,374	1,336	1,374	1,336	66.3	21.8	51.8	20.1	911	291	712	269
20-24	1,102	1,076	1,102	1,076	89.9	26.3	84.7	28.9	991	283	933	311
25-29	792	883	792	883	95.8	21.6	94.6	22.8	759	191	749	201
30-34	630	702	630	702	97.0	19.8	95.8	20.9	611	139	604	147
35-39	512	575	512	575	97.3	19.8	96.8	20.5	498	114	496	118
40-44	458	491	458	491	97.2	19.8	96.7	20.5	445	97	443	101
45-49	398	441	398	441	96.9	19.3	96.1	20.3	386	85	382	90
50-54	313	323	313	323	95.0	18.4	94.2	19.3	297	59	295	62
55-59	241	262	241	262	92.2	16.5	88.9	16.1	222	43	214	42
60-64	202	210	202	210	86.8	14.2	83.7	13.8	175	30	169	29
65-69	115	123	115	123	82.0	11.0	67.2	9.1	94	14	77	11
70-74	96	114	96	114	61.9	9.0	50.7	7.4	59	10	49	8
75-79	42	50	42	50	51.2	6.8	41.9	5.6	22	3	18	3
80+	36	51	36	51	31.6	4.1	25.9	3.4	11	2	9	2
Subtotals	7,761	8,068	11,877	12,087					5,715	1,424	5,382	1,438
Total both sexes	15,829		23,964						7,139		6,820	

Notes:

- indicates not applicable.

[a]Assume relative change in participation rates from 1951 to 1964 is repeated in 1964-1974.

[b]According to indirect evidence this number should be about 30 greater.

Sources:

Tables A-1, A-3, A-5.

Table A-7

ANNUAL AVERAGE RATES OF GROWTH OF LABOR FORCE
IN INTER-CENSUS PERIODS: 1951-1974
(percent)

Labor Force Group	1951[a]-1964	1964-1974 (C)[b]	1964-1974 (D)[b]
Male	2.05	3.37	2.75
Female	2.78	3.26	3.36
Total both sexes	2.19	3.35	2.88

Notes:

[a]DANE estimates officially adjusted at 11,589,000, of which 5,760,000 are assumed to be men and 5,829,000 women. It is further assumed that the percent of the total active population is the same as officially reported in the unadjusted census totals, i.e., 54.7 percent for men and 12.4 for women, yielding an estimated total economically active population in 1951 of 3,874,000.

[b]See Assumptions for C and D projection given in Table A-6.

1974 of between 2.9 and 3.4 percent, and perhaps more. This growth in the labor force will come predominantly from increased rates of entry into the labor force by young persons. These potential migrants will be the first to find their way to the cities. This marked acceleration in the growth of the urban labor force during the late 1960s and early 1970s will undoubtedly place severe strains on the capacity of the urban economy to expand employment opportunities adequately. This growth bottleneck or the shortage of urban jobs is dealt with by Slighton in the broader context of the development process.[1]

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[1]Robert L. Slighton, Urban Unemployment in Colombia: Measurement, Characteristics and Policy Problems.

Appendix B

STATISTICS

A SAMPLE OF COLOMBIAN MUNICIPALITIES

To measure migration a geographical unit is selected, which in Colombia is the municipality (municipio). From the 900 some municipalities in Colombia, averaging a population of about 2,000, a representative sample is drawn from those municipalities for which 1951 and 1964 census data are conterminous. This data requirement excludes from the sample frontier areas of Colombia for which administrative units have changed between 1951 and 1964. These excluded regions tend to be at the frontiers of settlement in Colombia; and though they constitute most of the land area, they contained only 3.4 percent of the population in 1951 and 4.2 percent by 1964 (see Table B-1).

The second condition, namely that the sample be representative, raises a question of interpretation. Either of two sampling procedures might be used; the probability of inclusion of a municipality in the sample could be proportional to its population size, or it could be equal for all municipalities, regardless of size. The first procedure gives greater representation to large cities where much of the population is concentrated, whereas the second procedure gives greater representation to rural regions where municipalities have small populations. Since this study is primarily concerned with rural out-migration, it was decided to obtain a sample of rural areas that is "representative" of the nation, and since the distinction between urban and rural is at best arbitrary, there should be at the same time no specific bias against the inclusion of randomly selected towns and cities. Since the average size of municipality varies widely among Departments (Departmentos) the sample is stratified at this level and the probability of selecting any given municipality is proportional to the average size of municipality in its Department. Consequently, a Department such as Boyaca with 1/5 of the country's municipalities but only 1/15 of the population does not constitute 1/5 of the sample, but rather 1/15 (Table B-1). This form of stratification reduces the

Table B-1

THE DISTRIBUTION OF COLOMBIAN POPULATION AND MUNICIPAL SAMPLE BY ADMINISTRATIVE REGIONS

Departments	Population 1964 Census (thousands)	Number of Municipalities	Average Municipality Population	Frequency in Sample
Antioquia	2,477	104	23,817	19
Atlantico	717	21	34,162	6
Bolivar[a]	1,006	43	23,395	8
Boyaca	1,058	127	8,332	9
Caldas	1,456	47	30,957	11
Cauca	607	33	18,400	5
Cordoba[a]	586	22	26,590	5
Cundinamarca[b]	2,820	109	25,862	22
Huila	416	34	12,235	4
Magdalena	789	31	25,451	6
Narino	706	49	14,400	6
Nord de Santander	534	35	15,257	4
Santander	1,001	75	13,346	8
Tolima	841	43	19,558	6
Valle del Cauca	1,733	42	41,261	13
Regions included in sample	16,748	815	20,550	132
Regions excluded from sample[c]	736	80[d]	9,200	0
Total population	17,484	895[d]	19,535	132

Notes:

[a]Cordoba was included with Bolivar in 1951 census, but municipalities appear to have not been subdivided, assuring geographic continuity between the censuses of 1951 and 1964.

[b]The special district of Bogota is treated as one municipality.

[c]Two departments were excluded, Choco with 181,862 population and Meta with 165,530. Also excluded were still less developed areas of the Intendencias with a combined population of 292,000 and the Comisarias with 96,000. Since both of the above departments were frontier regions in 1951, the geographic definitions of their municipalities have changed, precluding a 1951-1964 match of randomly selected municipalities. Population density per square kilometer is 37.53 in the sampled regions and 1.06 in the unsampled (frontier) regions of Colombia as of 1964.

[d]In the Intendencias and Comisarias the smallest administrative unit tabulated in the Census is counted here rather than municipalities.

variance of our estimates of population characteristics under study.

The big cities are, therefore, underrepresented in our sample of 131 municipalities. Nevertheless, three of the 18 largest cities in Colombia are contained in the sample with 14 other towns greater than 10,000, which together permit us to consider urban developments as well as those in the rural countryside. The municipal administrative center or Cabécera is virtually synonymous with the urban areas as defined by the Census to include towns with more than 1,500 inhabitants. For the country as a whole, 52 percent of the population lived in a Cabecera by 1964 and the same proportion, 52 percent, were classified as urban residents. In the sample the proportion of the population living in Cabeceras was only 38 percent (Table B-2).

ESTIMATION OF MIGRATION

A regional migration rate is designed to express a relation between a migration flow and the population subjected to that flow. Out-migration is expressed as a proportion of the resident migrant population, but it is difficult to relate in-migration symmetrically to the external population that is responsible for the inflow. For convenience, therefore, migration rates are usually defined as a ratio of the net migration flow to the domestic population, regardless of the direction of the net movement of persons. This conception of migration rate has met with wide acceptance, but different demographic methods are proposed to estimate it. There may appear to be no measurement problem here, but indeed since observations of the population on which migration estimates are based occur at discrete intervals rather than continuously, various changes occurring to the population in that interval must also be incorporated into the analysis.

Three processes may affect the size of an open population: some persons are born, some die, and some migrate into or out of the population. A migration rate is defined as the ratio of the net migration flow to overall population size. If vital statistics are accurate, births between censuses can be attributed to cohorts that are observed

Table B-2

COLOMBIAN MUNICIPALITIES SAMPLE: TOTAL AND CABECERAS POPULATION IN 1964

Department:	Municipality	Total Population	Cabeceras Population
Antioquia:	Amaga	17,043	4,381
	Angostura	12,167	1,720
	Barbosa	15,242	4,782
	Betania	15,092	2,748
	Campamento	10,208	1,384
	Caramanta	10,075	4,183
	Cisneros	9,720	7,554
	Concordia	16,367	5,187
	Entrerrios	4,380	1,384
	Fredonia	23,902	7,795
	Giraldo	3,523	839
	Guarne	13,788	3,940
	Jardin	14,213	4,387
	Remedios	13,793	2,090
	San Pedro	9,760	3,138
	Santo Domingo	13,956	3,018
	Sonson	40,316	16,955
	Turbo	42,851	7,375
	Zaragoza	12,149	2,134
Atlantico:	Baranoa	17,740	14,064
	Juan de Acosta	5,230	2,787
	Malambo	7,554	5,646
	Santo Tomas	8,112	7,505
	Soledad	38,456	37,617
	Usiacuri	4,230	3,611
Bolivar:	Achi	18,699	1,167
	Cordoba	11,513	2,705
	Corozal	42,011	14,000
	Morroa	5,817	2,036
	Palmito	5,238	2,296
	Sampues	13,599	5,380
	Tolu	12,578	7,954
	Turbaco	16,348	14,255
Boyaca:	Berbeo	5,617	133
	Chameza	2,161	253
	Firavitoba	6,025	1,107
	Iza	2,282	606
	Maripi	9,168	403
	Pachavita	5,778	315
	Raquira	5,970	313
	San Mateo[a]	10,370	1,090
	Socota	13,311	919

Table B-2 (continued)

Department:	Municipality	Total Population	Cabeceras Population
Cauca:	Mercaderes	18,109	2,376
	Patia	37,894	3,045
	Santander	32,846	11,426
	Sotara-Paispamba	9,386	416
	Toribio	8,964	846
Cordoba:	Monteria	126,329	70,531
	Cerete	29,666	11,849
	Sahagun	40,861	11,560
	San Bernado Del Viento	22,559	4,554
	San Pelayo	20,514	2,209
Cundinamarca:	Anolaima	23,885	3,307
	Bituima	4,653	315
	Cota	4,048	507
	Cucunuba	4,798	621
	Chipaque	8,874	1,733
	Choconta	13,332	3,379
	Fomeque	11,524	2,355
	Fosca	7,166	1,042
	Fuquena	4,137	252
	Fusagasuga	30,328	18,755
	Guataqui	2,450	1,371
	La Peña	6,955	846
	Nemocon	5,821	2,755
	Pandi	5,099	1,030
	San Antonia de Tena	9,879	496
	Silvania	11,953	1,549
	Simijaca	6,208	1,331
	Tabio	5,274	914
	Tibacuy	5,076	294
	Topaipi	9,163	501
	Viota	16,042	2,488
	Zipacon	3,932	865
Huila:	Agrado	5,005	2,751
	Colombia	8,546	1,599
	Iquira	3,593	1,858
	Paicol	2,956	920
Nariño:	Buesaco	15,369	2,278
	Contadero	4,685	914
	Cuaspud	4,920	1,090
	Cumbal	15,658	2,548
	Iles	5,310	890
	Magui	5,246	607

Table B-2 (continued)

Department:	Municipality	Total Population	Cabeceras Population
Valle:	Answermanuevo	19,010	5,510
	Dabien (Calilima)	12,679	6,117
	El Cerrito	20,835	12,200
	Ginebra	9,925	3,416
	Guarcari	16,085	6,447
	Palmira	140,889	106,502
	Pradera	19,762	11,223
	Restrepo	12,652	4,966
	San Pedro	9,053	1,527
	Toro	19,520	8,812
	Ulloa	4,860	1,407
	Vijes	6,105	2,047
	Yotoco	9,796	2,430
Norte de Santander:	La Playa	8,127	631
	Ragonvalia	5,395	1,898
	Salazar	13,027	3,020
	Silos	6,455	977
Caldas:	Aguadas	37,130	10,822
	Balboa	9,534	2,078
	Chinchina	26,306	15,944
	Filadelfia	17,022	3,576
	Mistrato	9,340	2,427
	Neira	19,659	7,672
	Pelestina	12,484	3,187
	Pijao	13,858	4,200
	Pueblo Rico	8,861	1,807
	Risaralda	17,484	3,144
	Samana	30,581	3,499
Magdalena:	Santa Marta	104,471	89,161
	Aracataca	22,202	5,304
	El Banco	31,479	14,889
	Puebloviejo	10,364	2,488
	Remolino	9,214	3,373
	Sitionevo	17,034	5,969
Santander:	Babichaba	13,417	2,798
	Cerrito	6,337	1,447
	Chipata	8,003	484
	Guaca	8,707	1,418
	La Paz	8,291	624
	Macaravita	6,029	204
	Palmar	1,954	529
	San Jose de Miranda	7,111	754

Table B-2 (continued)

Department: Municipality	Total Population	Cabeceras Population
Tolima: Falan	21,113	848
Herveo	12,215	2,313
Ortega	21,660	4,450
Piedras	5,288	924
Santa Isabel	8,134	2,489
Venadillo	13,344	6,931
Total population in sample:	2,058,166	777,003
Total population in sample universe	16,748,000	5,218,000
Percent sampled of universe	12.29	14.89

Note:

[a]Because data for population outside of the Cabecera was not published in 1951, this municipality is dropped from the sample for the purposes of analysis of migration between census periods.

in the second census, but since birth registrations are incomplete in Colombia, no estimate for migration is ventured for the cohort born between the two census dates. Migration rates for age cohorts completely enumerated in both censuses are, nevertheless, affected by deaths which reduce over time the population size or the denominator of the migration ratio. Were the migration rate measured instantaneously the frequency of death would not affect population size and thus would not bias a direct estimate of migration. But, as stated above, measurement of migration is typically based on widely separated observations, such as a decade between censuses, and estimates of migration rates based on such data must, therefore, deal with the effect of death on population size.

Consider a cohort of individuals of a specific age and sex. For a country experiencing no net migration, let this cohort consist of A_j persons age x at time 0, and t years later let there remain B_j persons in this cohort of age x+t. A survival rate R_j is defined as B_j/A_j where the subscript j stands for the specific age/sex cohort. By assumption the difference between A and B is attributed to deaths. If the frequency of deaths were constant over the time interval, the effect of death may be represented as an exponential rate of decline of the population.

$$A_j e^{-d_j t} = B_j \qquad (1)$$

where e is the base of natural logarithms, and d_j is the instantaneous death rate.

In an open (regional) population subjected to net migration, the difference between the base and final period population size is due to the effects of both death and migration. Assuming that the relative frequency of death and migration is constant over the interval considered, both exponential effects on population size may be shown.

$$A_{ij} e^{(m_{ij}-d_{ij})t} = B_{ij} \qquad (2)$$

where the i subscript distinguishes the region and m_{ij} is the age/sex/region specific average annual migration rate, greater than zero if there is net in-migration and less than zero if there is net out-migration.

Since age/sex specific death rates are not known for regional populations in Colombia, one must assume that $d_{ij} = d_j$ for all regions $i = 1,2,\ldots,N$. It is then possible to estimate m_{ij} from national survival data and regional age/sex population data from two censuses.[1]

$$m_{ij} = (\text{Log } B_{ij} - \text{Log } A_{ij} - \text{Log } R_j)/t \qquad (3)$$

This procedure for measuring migration rests on two assumptions: Censuses enumerate all (or a uniform proportion of) people and accurately report their age and sex, and age and sex specific death rates are uniform across regions analyzed. Without surveying the substantial literature devoted to the problems of measuring migration by survival estimation techniques, the remainder of this section indicates what margin of error may be introduced into our migration rate estimates because people are not accurately reported in the census, and age/sex specific death rates differ across regions of Colombia.[2]

Age is often systematically misreported, contributing to "age heaping" in the age profile of the population about attractive or

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[1] From equation (2), dividing by A_{ij} and taking natural logarithms yields

$$(m_{ij} - d_j)t = \text{Log } B_{ij} - \text{Log } A_{ij}, \qquad (a)$$

and since from equation (1), $d_j t$ is equal to Log (A_j/B_j), equation (a) is rewritten as

$$m_{ij} = (\text{Log } B_{ij} - \text{Log } A_{ij} - \text{Log } B_j + \text{Log } A_j)/t \qquad (b)$$

which is identical to equation (3) when B_j/A_j is replaced by R_j.

[2] For a review of this literature see C. Horace Hamilton, "Practical and Mathematical Considerations in the Formulation and Selection of Migration Rates," Demography, Vol. 2, 1965.

"round" ages. In Latin America, and in Colombia in particular, age heaping only moderately distorts the age profiles recorded in censuses.[1]

Where a greater proportion of a cohort is enumerated in the final year census than is counted in the initial year census, though no net migration may have taken place, the survival measure of migration will show net in-migration and vice versa when the final year count is less complete than the initial year.[2] Since the two Colombian censuses used in this study were 13 years apart, the five year age cohort in 1951 is survived to 1964, and then compared with a constructed cohort, which is a weighted average of the two adjacent five year cohorts reported in the 1964 census.[3] This unavoidable procedure may average out some patterns of age misreporting in the 1964 census, since persons often shift their age between adjacent age cohorts causing a regular oscillation in the age profile about the "true" one.

One method for judging the effect of age misreporting on estimated migration rates is to compute "implicit" migration rates for the total Colombian population between the censuses of 1951 and 1964. Since the population was virtually closed during this period, that is, no appreciable international migration occurred, the "implicit" migration estimates indicate the extent of age misreporting in the Colombian census data. Deviations in these "implicit" migration rates from zero show the magnitude and direction of errors one may expect to encounter in estimating migration rates from regional Colombian data. The errors are somewhat larger and more variable for women than for men as seen

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[1] Undernumeration of infants and young children is common to most censuses. In Colombia the deficit of children in the census enumerations appears to continue to age 14, and thereafter age groups are inflated to age 29. Beyond the age of 30 small vacillations occur, particularly among women, with relative deficits at ages 30-34 and 40-44 counterbalanced by relative surpluses in the intervening years.

[2] For example, if a relatively high proportion of the children age 0 to 4 are missed in the 1950 census and a lower proportion of those age 10 to 14 elude the 1960 census, there will appear to have been less out-migration or more in-migration than in fact occurred.

[3] See assumptions in note to Table B-3.

in Table B-3, but they balance out to an error of .05 percent annual in-migration for men between the ages of 0 and 44 in 1951, and a .21 percent annual out-migration for women. Though there is no a priori reason for age misreporting to be uniform across Colombia, it seems probable that errors in estimated migration rates due to age misreporting do not exceed an annual one percent change in reported cohort size, and summing several adjacent age cohorts should reduce the errors from age misreporting appreciably.

The second assumption underlying the measurement of migration is that death rates by age and sex are the same in all regions of the country. It is probable that death rates are higher for populations living in rural hinterlands of Colombia than for those in urban centers. But no correction for this weakness in our assumption is feasible since death registrations are incomplete. It may be supposed, therefore, that estimated out-migration from remote rural areas is overstated because of higher death rates prevailing in these areas, and conversely out-migration for more prosperous urban oriented areas is understated (or in-migration is overstated). The lack of information on regional death rates is thus likely to exaggerate differences in migration between rural and urban regions, though the actual magnitude of this bias appears small compared with the errors introduced by age misreporting. Substantial differences in the incidence of mortality lead to differences in annual migration estimates of only about .2 percent per year for the younger and older cohorts, and somewhat less for those in the prime of life.

COLOMBIAN DATA: ESTIMATION METHODOLOGY

Wages and Family Income

Information on the daily wage paid in each municipality for agricultural labor is collected quarterly and distinguished according to whether the employer provides food for his workers. There is no satisfactory way to estimate alternative employment opportunities for the potential migrant. The only other wage data for Colombia are collected from a

Table B-3

IMPLICIT AVERAGE ANNUAL MIGRATION RATES FOR THE CLOSED POPULATION OF COLOMBIA, 1951-1964

(percent annual growth (+) or decline (-) in apparent size of cohort)

Age Cohort in 1951	Men	Women
0-4	-.054	-.744
5-9	+.501	-.588
10-14	+.508	-.202
15-19	.000	+.186
20-24	-.210	-.189
25-29	-.330	+.213
30-34	.000	-.023
35-39	-.799	+.175
40-44	+.015	+1.054
0-44	+.051	-.206

Note:

The 1951 age/sex distribution of the population is survived to 1964 and compared with 1964 age/sex distribution. The difference is expressed as an annual rate of change on the intermediate base population. The following assumptions are made: (1) The "West" life table number 14 represents the regime of mortality prevailing in these years as estimated in Appendix A. See Table A-1 for population distribution in both censuses, and Table A-4 for survival factors. (2) .625 of each five year cohort is in the first three years and .375 in the last two years of each five year cohort.

sample of large manufacturing firms. This series for manufacturing wages in six city areas extends back to the mid-1950s.[1] According to these two data sources, rural and urban money wages increased from 1952 to 1965 between 14 and 17 percent per year (Table B-4). Consumer price indexes for a worker's budget are available from the mid-1950s in roughly the same urban areas as sampled for the manufacturing wage series, but these chained price indexes do not seem appropriate for deflating rural wages because both the basket of goods consumed by the rural wage earner is different from that consumed by the urban worker, and the prices the two pay may also differ markedly. Since it may be assumed that about 2/3 of a rural laborer's real income is spent on food, the local retail cost of food is probably the most adequate single deflator for rural wages. Deflating urban wages by urban price indexes and rural wages by the rural food prices, it is evident from Tables B-4 and B-5 that urban real wages (on an hourly or weekly basis) increased between 2.7 and 4.0 percent per year between about 1952 and 1965, but rural real daily wages did not increase significantly.[2] The price of food rose more sharply in rural areas of Colombia than it did in urban areas. This change in the relative price of food in rural and urban markets may have been due to the increasing efficiency of the transportation and commerce network serving urban consumers.[3]

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[1]The wage data are presented for departments, but there corresponds to each department a major city in which are situated virtually all the large manufacturing firms. Consequently, it does not seem unrealistic to assume that these wage series (are designed to) represent the relative change in manufacturing wages in these six most important manufacturing cities.

[2]The differential between daily wages without food and daily wages paid where the employer provided food was treated as a price of the basket of food consumed by the rural labor force. This differential was used to deflate rural wages (excluding food).

[3]If the Bogota consumer price index or a GNP deflator is used to deflate rural wage series, a more sanguine picture emerges. By this procedure, Berry finds that rural real wages increased at about 1.5 percent per year from 1950 to 1964. Urban manufacturing wages, nevertheless, increased still more rapidly. Chapter 5 of forthcoming book on Colombian Agriculture.

Table B-4

RURAL AND URBAN WAGE MOVEMENTS IN COLOMBIA: 1952 TO 1965

	Mean	Standard Deviation
Daily wages in agriculture (Sample 131)		
Level 1956 excluding food (pesos per day)	3.88	.96
Level 1956 including food (pesos per day)	2.37	.70
Annual rate of growth 1952-1965		
Excluding food	14.77	7.93
Including food	16.62	7.87
Real deflated (for food costs)	.14	2.74
Wages in manufacturing (six cities)		
Annual rate of growth 1952-1965		
Hourly wages	15.6	n.a.
Weekly wages	13.7	n.a.
Real deflated hourly wages	2.7	n.a.
Real deflated weekly wages	4.0	n.a.

Note:
n.a. indicates not appropriate given the data sources.

Source:
Rural wage from sample data. Urban wage data from Table B-5, estimated and chained for some cities in early 1950s for lack of published series.

Table B-5

REAL AND MONEY WAGES OF WORKERS IN MAJOR COLOMBIAN CITIES: 1952-1965
(in pesos)

	Bogota	Medellin	Cali	Barranquilla	Bucaramanga	Manizales
Hourly earnings 1952	.69	.66	.67	.73	.52	.50
Weekly earnings 1952	41.4	39.6	40.2	41.6	29.6	30.0
Cost of living 1952[a]	85	84	86	93	82	87
Real hourly earnings 1952[a]	.81	.79	.78	.78	.63	.57
Real weekly earnings 1952[a]	48.7	47.1	46.7	44.7	36.1	34.5
Hourly earnings 1965	3.55	3.65	3.71	3.32	3.81	3.01
Weekly earnings 1965	177.5	178.9	185.5	166.0	194.3	147.5
Cost of living 1965[a]	282	288	292	298	309	281
Real hourly earnings 1965[a]	1.26	1.27	1.27	1.11	1.23	1.07
Real weekly earnings 1965[a]	62.9	62.1	63.5	55.7	62.9	52.5
Annual increase in worker's real hourly earnings 1952 to 1965 in percent[b]	3.5	3.7	3.8	2.8	5.3	5.0
Annual increase in worker's real weekly earnings 1952 to 1965 in percent[b]	2.0	2.2	2.4	1.7	4.4	3.3

Notes:

[a]July 1954 to June 1955 equals base of 100. Index is joined with earlier ones before 1954 and with later one after 1962.

[b]Average annual continuously compounded rates of growth.

Source:

Wage and price data derived from various Monthly and Annual Statistical Publications of DANE.

For the distribution of individuals and family income in 1965-1966 by rural-urban residence, see Tables B-6 and B-7.

Population Growth or Surviving Fertility

From a cross-section of some 50 countries, Bogue and Palmore have estimated the linear association between various direct and indirect measures of fertility. Using their regression coefficients for the relationship among four ratios based on the child composition of the population, the crude birth rate "estimates" are calculated for each municipality in the sample for 1951 and 1964.[1] These estimates of the regional birth rate do not take account of the level of child mortality which tends to be higher in high fertility regions and vice versa. Consequently these birth rate estimates do not reflect accurately underlying fertility differences among regions, but a hybrid called here "surviving fertility." This hybrid, however, may be closely associated with differences in the labor force growth in the following decade, were there no net migration into or out of the region. Unweighted average values of these variables and others for the Colombian sample are shown in Table B-8.

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[1]The average of these four estimates is used as a measure of "surviving fertility" for the decade before the census. Donald J. Bogue and James A. Palmore, "Some Empirical and Analytic Relations among Demographic Fertility Measures with Regression Models for Fertility Estimation," Table 8, p. 325.

Table B-6

DISTRIBUTION OF PERSONS IN COLOMBIA BY RURAL-URBAN RESIDENCE AND FAMILY INCOME, 1965 1966[a]
(percent)

Family Income (pesos)[b]	Residence		
	Total	Urban	Rural
3,600 or less	39.6	22.6	58.0
3,601 to 6,000	21.9	19.6	24.3
6,001 to 12,000	21.9	31.1	12.0
12,001 or more	16.6	26.7	5.7
Total (in percent)	100.0	100.0	100.0
Total (in thousands of pesos)	18,042	9,294	8,748

Notes:

[a]Based on the National Health Survey findings from a stratified probability sample of the non-institutional population of Colombia. 9600 dwellings representing approximately 52,500 persons were interviewed.

[b]The value of peso fluctuated in the period of the survey between 11 and 19 pesos to a dollar.

Source:

"Social Science and Health Planning: Culture, Disease and Health Services in Colombia," Milbank Memorial Fund Quarterly, Vol. 46, No. 2, April 1968, Part 2, Appendix B, Table 2, p. 336.

Table B-7

MEDIAN FAMILY INCOME IN COLOMBIA BY RESIDENCE AND EDUCATIONAL ATTAINMENT, 1965-1966[a] (pesos[b])

Educational Attainment of Head of Household	Residence		Absolute Difference Between Urban and Rural Incomes
	Urban	Rural	
None	5,139	3,043	2,105
Primary	7,162	3,401	3,761
Secondary	12,949	6,088	6,861
College	30,432	22,342	8,091

Notes:

[a]Based on the National Health Survey findings from a stratified probability sample of the non-institutional population of Colombia. 9600 dwellings representing approximately 52,500 persons were interviewed.

[b]The value of peso fluctuated in the period of the survey between 11 and 19 pesos to a dollar.

Source:

"Social Science and Health Planning: Culture, Disease and Health Services in Colombia, Milbank Memorial Fund Quarterly, Vol. 46, No. 2, April 1968, Part 2, Appendix B, Table 2, p. 336.

Table B-8

UNWEIGHTED AVERAGE OF MUNICIPAL POPULATION CHARACTERISTICS AS ESTIMATED FROM SAMPLE

	Average or Mean	Standard Deviation
Residence (percent)		
Cabecera (1964)	28.76	20.89
Cabecera (1951)	22.12	16.30
Urban: towns greater than 2,500 (1964)	26.18	25.89
Education 1964 (percent)		
Some primary education		
Aged 5 to 9	22.19	8.22
Aged 10 to 14	69.83	13.80
Aged 15 to 59	61.72	10.40
Some secondary education		
Aged 15 or older	4.52	3.46
Literacy (percent)		
Aged 10 to 14 (1964)	70.74	14.65
Aged 15 to 59 (1964)	67.61	12.69
Aged 7 or older (1951)	53.12	11.53
Economically active in labor force 1964 (percent of those persons aged 15 to 59)		
Men	107.69	9.93
Women	16.02	8.19
Surviving fertility estimate per thousand per year (crude birth rate estimate biased down due to heavy child mortality)		
1964 Census (1955-1964)	46.47	3.66
1951 Census (1942-1951)	40.79	3.84

Appendix C

CAUSES OF VIOLENCE

The relation between migration and violence may be more complex than implied in the text, for migration and violence may be caused by similar features of the local environment that are not statistically independent of one another. Rather than assuming that violence is predetermined in the migration equation (4), it may be more realistic to presume it stems from a variety of factors such as the level and rate of change in standards of living, the local distribution of land ownership, the proportion of non-native-born residents, adequacy of housing, or a variety of other political, social, and economic causes adduced by many inquiries into the causes of the violence. The regression results summarized in Table C-1 give some confirmation that the frequency of violence is indeed associated with rural wage level, the tenancy rate, and measures of prior in-migration. Housing, arable land, mechanization, and growth in wages were among the variables examined but not found to be associated significantly with the frequency of violence.

Conclusions from these results should be drawn with caution, however, for it is not clear which way causality runs. Violence may shift the supply curve of labor to the left forcing land owners to pay higher wages to retain the necessary local labor. Alternatively, high wage regions, in which workers are unable to alter their tenant status, may take to violence to redress their frustrated aspirations. Whatever the direction and chain of causality, simultaneous equation bias introduced by treating violence as predetermined probably leads to underestimating the independent and countervailing effects of wages and violence on regional migration rates.

Table C-1

THE PREVALENCE OF LAWLESSNESS IN COLOMBIA, MEASURED IN TERMS OF REPORTED HOMICIDES IN THE YEARS 1958-1963 DUE TO LA VIOLENCIA PER 100,000 INHABITANTS IN MUNICIPALITIES IN 1964

Regression Number	Constant Term	Wages per Day 1956	Rooms per Person 1950	Agriculture 1960			Percent of Males not Born in Region (1964)	R^2
				Arable Hectares per Person	Tenant Proportion	Tractors per Person		
1	-33.89	10.396	-30.956	11.488	2.99	.608	.209	.303
		(4.74)	(-1.84)	(1.85)	(2.58)	(1.42)	(1.55)	
2	-32.01	10.019	-27.961	8.032	2.47	NI	.284	.292
		(4.58)	(-1.66)	(1.40)	(2.23)		(2.27)	
3	-29.42	9.893	-23.002	NI	2.30	NI	.274	.281
		(4.51)	(-1.39)		(2.08)		(2.19)	
4	-39.13	9.246	NI	NI	2.38	NI	.250	.269
		(4.30)			(2.16)		(2.01)	

Notes:

NI indicates variable not included in regression.
Variables are defined in Notes to Table 11.